ARCHIVES OF SURGERY

VOLUME 54 · JUNE 1947 NUMBER 6

COPYRIGHT, 1947, BY THE AMERICAN MEDICAL ASSOCIATION

TRAUMATIC RUPTURE OF THE LIVER WITHOUT PENETRATING WOUNDS

A Study of Thirty-Two Cases

LOUIS T. WRIGHT, M.D.

AARON PRIGOT, M.D.

AND

LYNDON M. HILL Jr., M.D.

NEW YORK

THIS paper is based on 32 cases of traumatic rupture of the liver without penetrating wounds studied by us at Harlem Hospital. The present report covers cases observed during the period from Jan. 1, 1935 to Jan. 1, 1946, and a few scattered cases of which the records are still available which occurred prior to this period. In all the cases in this series operation or autopsy proved the liver to be injured.

Subcutaneous rupture of the liver due to trauma is not so infrequent as one is led to believe by the scattered reports in the literature. In a study from this hospital of traumatic subcutaneous rupture of the normal spleen,[1] covering the period from Jan. 1, 1928 to Sept. 1, 1938, it was shown that approximately 20,000 patients were admitted to the Traumatic Service of Harlem Hospital. Eighteen of these patients had subcutaneous rupture of the liver. This indicates roughly an incidence of 1 to 1,111. In the present series there are 27 cases of subcutaneous rupture of the liver (excluding 5 scattered cases) due to trauma in 34,000 admissions to the traumatic service during the period covered by this report. This indicates roughly an incidence of 1 to 1,259, which compares closely to the foregoing figures and to the figure of 1 to 1,300 reported by Thorlakson and Hay [2] from the Winnipeg General Hospital.

The liver is the largest intra-abdominal organ, and it would be reasonable to expect it to be the most frequently injured. In a study of 365 cases of subcutaneous injury to the solid viscera, Edler [3] reported

---

Read at the meeting of the Harlem Surgical Society May 1, 1946.

1. Wright, L. T., and Prigot, A.: Traumatic Subcutaneous Rupture of the Normal Spleen, Arch. Surg. **39**:551-576 (Oct.) 1939.

2. Thorlakson, P. H. T., and Hay, A. W. S.: Rupture of the Liver, Canad. M. A. J. **20**:593-598 (June) 1929.

3. Edler, L.: Die traumatischen Verletzungen der parenchymatösen Unterleibsorgane (Leber, Milz, Pankreas, Nieren), Arch. f. klin. Chir. **34**:343-409, 1887.

the liver to be involved in 189 cases, and the spleen, kidney and pancreas in 176 cases. Although this high percentage was not borne out in a study by us of rupture of the normal spleen without penetrating wounds, the present series shows a greater frequency of injury to the liver (table 1). Combining the two series shows that the liver and spleen are injured in about the same number of cases and that together they make up 72 per cent of all intra-abdominal injuries.

Our experience shows that seasonal and yearly variations are unimportant. It is of interest to note, however, that during the period of gasoline rationing, 1942 to 1945 inclusive, only 1 case is noted.

TABLE 1.—*Incidence of Rupture of the Liver and Other Abdominal Viscera Without Penetrating Wounds in Two Series of Cases*

Organ Ruptured	Present Series of Cases 1935-1946		Previous Series of Cases 1928-1938		Totals	
	Number	Percentage	Number	Percentage	Number	Percentage
Liver *	27	38.6	18	28.6	45	33.8
Spleen	23	30.7	30	47.6	53	38.4
Intestines	16	21.3	11	17.5	27	19.5
Mesentery	2	2.7	3	4.7	5	3.6
Pancreas	2	2.7	1	1.6	3	2.2

* Five cases not included in the 27 occurred betweeen 1935 and 1938. They have never, however, been described before. The cases of ruptured spleen, intestines, mesentery and pancreas do not overlap in the two series of cases.

TABLE 2.—*Trauma in Cases of Rupture of the Liver*

Traumatic Agent	Number of Cases	Percentage
Struck by motor vehicle	19	59.4
Fall from window	8	25.0
Fall down stairs	2	6.2
Assault and battery	1	3.1
Struck by streetcar	1	3.1
Undetermined	1	3.1

As shown in table 2, the motor vehicle is the traumatic agent in the greatest number of cases. In the 19 cases caused by motor vehicles, in only 1 instance did the history obtained indicate that the vehicle passed over the body of the injured.

Correlation of the age and sex incidence with the type of trauma reveals some interesting facts (table 3). Twenty-one cases or 65.6 per cent occurred in males and 11 or 34.4 per cent in females. Of the 19 cases involved in motor vehicle accidents, 13 or 68.4 per cent occurred in males and 6 or 31.6 per cent in females. The 8 cases due to falls from windows show the sex distribution to be equal. Two males fell downstairs. The 1 case of assault and battery involved a female; 1 male was struck by a streetcar. In 1 male no history of trauma was elicited, but he also had a ruptured spleen.

In the youngest age group, 2 to 3 years, it will be noted that the 2 cases were caused by falling out of windows. As children become older and escape from parental care, accidents in the home decrease and those outdoors increase.

For the ten year period 15 to 24 years, inclusive, we have no cases. In this age group the young adult is either so agile that injury is avoided or so reckless that the injury is almost immediately fatal, and hospitalization is not required.

A study of the types of lacerations and the lobes and surfaces of the liver involved in injury without penetrating wounds is of interest and reveals some important facts.

TABLE 3.—*Age and Sex of Patient Correlated with Trauma*

	Sex		Type of Trauma							
Age	Male	Female	Motor Vehicle	Fall from Window	Fall Down Stairs	Struck by Bus	Struck by Streetcar	Assault and Battery	Undetermined	Total
2	..	1	..	1	..	..	..	..	..	1
3	..	1	..	1	..	..	..	..	..	1
4	1	..	1	..	..	..	..	..	..	1
6	..	2	2	..	..	..	..	..	..	2
8	1	..	1	..	..	..	..	..	..	1
11	..	2	1	1	..	..	..	..	..	2
12	3	1	3	..	..	1	..	..	..	4
14	1	..	..	..	1	..	..	..	..	1
25	2	..	..	2	..	..	..	..	..	2
26	2	1	2	..	..	..	..	..	1	3
17	2	..	1	1	..	..	..	..	..	2
28	..	1	..	1	..	..	..	..	..	1
35	1	..	1	..	..	..	..	..	..	1
37	..	1	..	..	..	..	..	1	..	1
39	1	..	1	..	..	..	..	..	..	1
42	1	..	1	..	..	..	..	..	..	1
43	1	..	1	..	..	..	..	..	..	1
45	1	..	1	..	..	..	..	..	..	1
46	1	..	..	..	1	..	..	..	..	1
49	1	..	1	..	..	..	..	..	..	1
50	1	..	..	..	..	..	1	..	..	1
63	1	..	1	..	..	..	..	..	..	1
68	..	1	1	..	..	..	..	..	..	1
Total	21	11	19	7	2	1	1	1	1	32

The liver is the largest gland within the abdominal cavity. Its friability and its position, suspended at the base of a bony cage consisting of the vertebral column posteriorly, the firm costal margin laterally and the abdominal wall and xiphoid process of the sternum anteriorly, combine to render the liver vulnerable to direct injury and injury by contrecoup. The right lobe, being larger and less protected than the left, is more easily injured.

NATURE OF LACERATION

The nature of the laceration of the liver also varies. Moorhead's [4] experience, as well as our own, reveals a tendency of the liver to split

4. Moorhead, J. J.: Traumatic Surgery, ed. 2, Philadelphia, W. B. Saunders Company, 1923, p. 647.

and crack in more or less a stellate manner with considerable hemorrhage and escape of bile. The right lobe is not infrequently split and is usually the site of central ruptures. In our series we have no transverse lacerations. Wakeley [5] believes that this type does not bleed so freely as the vertical laceration.

As is shown in table 4, the right lobe was injured in 27 cases, the left lobe in 2 cases and both lobes in 3 cases. The figures support

TABE 4.—*Lobes and Surfaces Involved in Ruptured Liver*

Case	Right	Left	Both	Free Blood in Peritoneal Cavity	Results of Abdominal Tap
1	Inferior surface	.....	.....	Large	Positive
2	.....	.....	Extensive	Large	None
3	Split	.....	.....	Pus and blood	Positive
4	Split	.....	.....	Large	Positive
5	Dome	.....	.....	Large	None
6	Lateral surface	.....	.....	Moderate	Positive
7	Anterior surface	.....	.....	Moderate	None
8	Dome	.....	.....	Large	Positive
9	Posterior surface	.....	.....	Moderate	None
10	Split	.....	.....	Large	Positive
11	Dome	.....	.....	Large	Positive
12	Split	.....	.....	Large	Positive
13	Dome	.....	.....	Moderate	None
14	Dome	.....	.....	Moderate	None
15	Dome	.....	.....	Large	None
16	Split	.....	.....	Large	None
17	Dome	.....	.....	Large	None
18	Dome	.....	.....	Large	None
19	.....	Through and through	.....	Large	Negative
20	.....	.....	Anterior surface	Large	None
21	Dome	.....	.....	Large	Negative
22	.....	.....	Anterior surface	Large	None
23	Central	.....	.....	Large	None
24	Dome	.....	.....	Large	Negative
25	Dome	.....	.....	Large	None
26	Anterior surface	.....	.....	Large	None
27	Dome	.....	.....	Large	None
28	Dome	.....	.....	Large	Positive
29	Dome	.....	.....	Large	Peritoneoscopy, pos.
30	Posterior surface	.....	.....	Large	Positive
31	.....	Posterior surface	.....	Large	None
32	Posterior surface	.....	.....	Moderate	Positive

Bleeding—Small: 0 to 200 cc.; moderate: 200 cc. to 500 cc.; large: 500 cc. and over

Moynihan's [6] statement that the right lobe is injured six times as frequently as the left lobe.

A study of the surfaces of the liver injured shows the dome of the right lobe involved in 14 cases, the posterior surface in 3 cases, the

5. Wakeley, C. P. G.: Hepatic Injuries, Clin. J. **65**:437-442 (Nov.) 1936.

6. Moynihan, B.: Abdominal Operations, Philadelphia, W. B. Saunders Company, 1926, vol. 2, p. 236.

anterior surface in 3 cases, the inferior surface once and the lateral surface once. The posterior surface of the left lobe was involved once and the anterior surface of both lobes twice. In all, the posterior surface was involved in only 4 cases. This tends to disprove the statement current in the literature that most ruptures are said to occur along the posterior inferior surface owing to the fact that during injury the liver is thrown against the vertebral column.[7] In 6 of our cases the liver was actually split, the right lobe five times and the left lobe once. We have 1 case of central rupture. In table 5 we compare our experience in the frequency of involvement of various surfaces of the liver with that of Lamb.[8]

The amount of blood in the abdominal cavity or under the capsule in rupture of the liver is usually moderate or large in amount. The reasons for copious hemorrhage are as follows: the thin-walled hepatic veins are without valves and do not retract or contract; blood mixed with bile does not clot so easily; the respiratory movements of the

TABLE 5.—*Frequency of Involvement of Various Surfaces of the Liver*

Surface	Lamb's Series, Percentage	Our Series, Percentage
Dome	41.0	43.7
Inferior	25.0	3.1
Anterior	6.3	21.8
Posterior	6.0	12.5
Lateral	12.5	3.1

diaphragm aggravate the injury; hepatic tissue is friable, easily displaced by hemorrhage and therefore does not act as a tampon. In all our cases there was a moderate or large amount of blood in the peritoneal cavity. In 1 case the patient refused operation for eight days, and pus and blood were found in the peritoneal cavity at operation. We use the term "moderate" to denote 200 to 500 cc. of blood and clots; below that figure, "small," and above it, "large."

How much trauma is necessary to cause rupture of the liver? In a paper on rupture of the spleen without penetrating wounds [1] we showed that the trauma could be mild; therefore associated lesions are not common. Of 30 cases of rupture of the spleen without penetrating wounds, in 13, or 43.3 per cent, there were no associated lesions. In traumatic subcutaneous rupture of the liver, there were no associated lesions in 10, or 31.3 per cent. The trauma therefore necessary to cause rupture of the liver is usually severer.

7. O'Neill, J. N.: Traumatic Rupture of the Liver, California & West. Med. **54**:68-70 (Feb.) 1941.

8. Lamb, C. A.: Rupture of the Liver, New England J. Med. **221**:855-859 (Nov. 30) 1939.

Robin [9] and others have reported rupture of the liver in cases due to minimal trauma; but Sciacca,[10] in studying spontaneous rupture of the liver and cases with minimal trauma, came to the conclusion that in such cases the parenchyma of the liver is not normal. Devic and Bériel [11] stated that "in traumatic rupture, the rupture is the cause of the hemorrhage. In spontaneous rupture, the hemorrhage is the cause of the rupture."

Since the trauma in rupture of the liver without penetrating wounds is severer, associated lesions are commoner. In the present series we

TABLE 6.—*Associated Lesions in Twenty-Two Cases of Rupture of the Liver*

	Lacerations							Fractures					Ruptures		
								Ribs							
Case No.	Brain	Lung	Kidney	Heart	Mesentery	Bladder	Severe	Left	Right	Skull	Multiple	Compound	Spleen	Intestines	Trauma
1	1	..	1	..	..	..	..	..	..	1	..	..	..	..	Fall
2	..	..	..	..	..	..	1	..	..	..	1	1	..	..	Fall
3	1	..	..	..	..	..	..	..	..	..	..	..	1	..	Automobile
4	..	..	..	..	..	..	..	..	..	..	..	..	..	1	Automobile
5	..	..	..	..	..	..	..	..	1	..	..	..	..	..	Streetcar
6	..	1	..	..	1	..	..	..	1	..	..	..	..	..	Automobile
7	..	..	..	..	..	..	..	..	..	..	..	..	..	1	Automobile
8	1	..	..	..	..	..	..	..	..	1	..	..	..	..	Automobile
9	..	..	1	..	..	..	..	..	..	..	..	..	..	..	Fall
10	..	1	..	..	..	..	..	1	..	..	..	1	..	..	Automobile
11	..	..	..	..	..	..	..	1	1	..	..	..	..	..	Automobile
12	..	..	..	..	..	..	..	..	..	..	1	..	..	..	Fall
13	..	1	..	1	..	..	..	..	..	..	..	..	1	..	Automobile
14	..	1	..	..	..	..	..	..	..	..	1	..	..	..	Fall
15	1	..	..	..	..	..	1	..	..	..	..	..	..	..	Automobile
16	..	..	..	..	..	..	..	..	..	..	..	1	..	..	Automobile
17	..	..	..	..	..	..	..	..	..	..	1	..	..	..	Automobile
18	1	..	1	..	..	..	..	..	..	..	..	..	1	..	Fall
19	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Automobile
20	..	..	..	..	..	1	..	..	..	..	..	..	..	..	Automobile
21	..	..	..	..	..	..	..	..	..	..	1	..	..	..	Automobile
22	..	..	..	..	..	..	..	..	..	..	..	..	1	..	No history
Total	5	4	3	1	1	1	2	2	3	2	5	3	5	2	

have but 10 cases without associated lesions. Of these 10, 5 were due to motor vehicle accidents; 2 were caused by falls from windows; 2 by falling down stairs, and 1 was the result of assault and battery.

The frequency and severity of the various associated lesions in the order of their occurrence is shown in table 6. There were 22 cases in

9. Robin, I. G.: Case of Ruptured Liver Due to Trivial Violence, Guy's Hosp. Rep. **84**:100-103 (Jan.) 1934.

10. Sciacca, F.: Le rotture quasi spontanee del fegato, Policlinico (sez. chir.) **44**:254-263 (May) 1937.

11. Devic, E., and Bériel, L.: L'apoplexie hépatique dans la syphilis: Considérations sur les ruptures spontanées du foie, Ann. de dermat. et syph. **7**:642-665, 1906.

which severe associated lesions were present. The traumas in these cases were as follows: 14 motor vehicle accidents, 6 falls and 1 street-car accident; in the last case there was no history of trauma, but we believe that the patient was injured while under the influence of liquor, because he also had a ruptured spleen.

From table 6 one can study the frequency of associated lesions. Lacerations of the brain and spinal cord, proved by spinal tap, and ruptured spleen each occurred five times. In 5 cases there were multiple fractures, simple and compound (exclusive of fractures of ribs). It is of interest to note that fractures of the ribs appeared five times in 4 cases, the right side being involved in 3 cases, both sides in 1 case and the lower ribs on the left side in 1 case. In all these cases the right lobe of the liver was involved in the rupture.

CLASSIFICATION OF TRAUMATIC RUPTURE

Since the associated lesions occur so frequently and are so severe as to obscure the diagnosis, each of these cases must be studied and evaluated individually. We shall base our classification of traumatic rupture of the liver on the cases in which no complications were present.

There is considerable variation in the clinical manifestations of hepatic rupture due to the character of the internal concealed hemorrhage which dominates the symptoms, and classification therefore is not easy. It is clear that any classification must be elastic.

Hitzrot's [12] and Moynihan's [6] classifications are based on the pathologic findings. Hitzrot's classification is as follows:

1. Subcapsular rupture
   a. Central
   b. Subcapsular
2. Rupture of both capsule and parenchyma

Moynihan proposed the following classification:

1. Rupture of the liver with laceration of Glisson's capsule
2. Separation of the capsule with subcapsular hemorrhage
3. Central rupture with formation of abscess or cyst

Inasmuch as the clinical manifestations of traumatic rupture of the liver without penetrating wounds not infrequently bear no relation to the severity of the rupture, we offer a classification dependent on the rate of hemorrhage. The rate of hemorrhage at times may not be in proportion to the amount of damage to the liver. Vance,[13] studying cases which came to autopsy, confirmed our impression. He found in

12. Hitzrot, J. M.: Subcutaneous Injuries of the Liver, Ann. Surg. **66**:50-63 (July) 1917.

13. Vance, B. M.: Subcutaneous Injuries of Abdominal Viscera: Anatomic and Clinical Characteristics, Arch. Surg. **16**:631-689 (March) 1928.

a study of 21 cases that 33.3 per cent of the patients died at the site of injury, 38.1 per cent died within the first six hours and 28.6 per cent lived a sufficient length of time for an adequate clinical study.

In our opinion there are four clinical types as follows:

1. Massive hemorrhage, causing almost immediate or sudden death
2. Acute hemorrhage, producing shortly after the injury a state of shock which rapidly becomes deeper
3. Repeated small hemorrhages; the patient enters the hospital in good condition but shows signs of slow progressive hemorrhage, increasing anemia, a rising pulse rate, a fall in blood pressure and progressive weakness, or the signs and symptoms may disappear except for pain in the liver area and then recur gradually or with dramatic suddenness; the reappearance of signs of internal concealed hemorrhage may occur at any time from one day to even months later.[14]
4. Spontaneous cure; the patient shows evidence of injury to the liver with signs of internal concealed hemorrhage; symptoms disappear in due time.

A presumable case of type 4 was seen recently.

The patient, a man 40 years of age, fell three stories. He was brought into the hospital in extreme shock. His blood pressure was 90 systolic and 60 diastolic, and the pulse rate was 130. Rigidity of the upper part of the abdomen was present on the right side. Roentgen rays showed pneumothorax of the right side, fracture of the seventh, eighth, ninth and tenth ribs on the right side in the nipple line and fractures of the transverse processes of the first, second, third, fourth and fifth lumbar vertebrae on the right. Abdominal tap was done six hours after admission, and 2 cc. of blood was obtained. The patient was seen in consultation by various members of the staff. Their opinion was divided as to the seriousness of any intra-abdominal injury. He was carefully observed, and at the end of thirty-six hours his abdominal symptoms had subsided. He was treated conservatively. At the end of seventy-two hours he presented no abdominal signs of any character; at the end of a week he was out of bed and wanted to go home.

Because of the location of the multiple fractures of the ribs over the right lobe of the liver, together with fractures of the right transverse processes of the lumbar vertebrae, and the blood obtained from the abdominal cavity by means of abdominal tap from the right upper quadrant, it is most likely that the bleeding was from a small laceration due to rupture of the right lobe of the liver. This case, therefore, is presumably one of spontaneous recovery.

14. (*a*) Robertson, D. E., and Graham, R. R.: Rupture of the Liver Without Tear of Capsule, Ann. Surg. **98**:899-903 (Nov.) 1933. (*b*) Wulsten, J.: Zur Klinik und Pathologie der zentralen Leberruptur, Beitr. z. klin. Chir. **153**:424-436, 1931. (*c*) Corriden, T. F.: Subcapsular Rupture of Liver in Child, Surgery **8**:446-455 (Sept.) 1940. (*d*) Christopher, F.: Rupture of Liver, Ann. Surg. **103**:461-464 (March) 1936. (*e*) Robertson, D. E.: Rupture of Liver Without Tear of Capsule, ibid. **106**:467-469 (Sept.) 1937. (*f*) Brandberg, R.: Beitrag zur Klinik der traumatischen Leberverletzungen bei unverletzter Kapsel, Acta chir. Scandinav. **63**:321-345, 1928.

In our series we have 1 case of massive hemorrhage. In this case the right lobe of the liver was found to be split.

In case 16 of table 4 a 6 year old girl was said to have been struck by an automobile one-half hour before admission to the hospital. Physical examination revealed a girl in profound shock; her blood pressure was not obtainable. The abdomen was soft. The patient died fifteen minutes after admission. The necropsy revealed laceration of the right lobe of the liver, practically split in half in a sagittal direction.

In the group in which acute hemorrhage occurs the patient, although brought to the hospital shortly after the accident, is in shock on admission. The patient's condition becomes progressively worse as the shock deepens. This group is illustrated by the following case.

The patient in case 9 of table 4, a 12 year old girl, was said to have been struck by an automobile shortly before admission. Physical examination revealed a girl in shock, with a blood pressure of 85 systolic and 60 diastolic. The abdomen was soft with slight tenderness in the upper part. The patient was given antishock therapy, and despite this the blood pressure fell to 70 systolic and 50 diastolic. The abdomen became more tender in the left upper quadrant, with slight rigidity. A diagnosis of ruptured spleen was made and an operation performed. At operation a 5 inch (12.7 cm.) laceration of the posterior aspect of the right lobe of the liver was found. There was a moderate amount of blood in the peritoneal cavity. The tear in the liver was packed with gauze. Postoperatively the patient went downhill and died the next day with a temperature of 104 F. Postmortem diagnosis was rupture of the liver, hemorrhage and shock.

In cases of repeated small hemorrhages after the initial injury, the patient's condition gradually becomes worse, with obscure abdominal symptoms and progressive weakness; the patient may be relatively free of symptoms except for pain in the area of the liver, until a mass appears in the right upper quadrant or until the liver becomes enlarged. This period, relatively free from symptoms, may be suddenly terminated by a dramatic episode of sudden onset of acute hemorrhage or the reappearance of signs of slow hemorrhage. The following case is illustrative.

The patient in case 5 of table 4, a 46 year old man, fell down a flight of stairs two days before admission. During the fall he struck his abdomen. The patient was not unconscious but felt weak. After the fall he experienced steadily increasing generalized abdominal pain, worse on motion. He felt weaker. Physical examination revealed a well developed, well nourished man. Blood pressure was 146 systolic and 74 diastolic. There were tenderness over the right costal margin and rigidity in the right upper quadrant. Laboratory studies revealed an icteric index of 27, a white blood cell count of 19,600 and a red blood cell count of 4,900,000; the hemoglobin value was 80 per cent.

Exploratory laparotomy revealed two deep lacerations, one 2¾ inches (7 cm.) long, the other 2 inches (5.1 cm.) in length on the dome of the liver. There was 500 cc. of free blood and clots in the peritoneal cavity. Lacerations of the liver were packed with gauze. On the second postoperative day a type 20 pneumonia of the lower lobe of the right lung developed, and the patient died on the third postoperative day. Necropsy revealed lacerations of the liver, lobar pneumonia, infarction and necrosis of the middle portion of the right lobe of the liver.

We have no cases of repeated small hemorrhages with formation of a mass in the area of the liver, but they have been reported in the literature.[14] Robertson's and Graham's cases showed a slowly developing mass in the hepatic area. In central rupture the liver may be found enlarged and palpable.

As far as we have been able to ascertain, no cases of spontaneous recovery from rupture of the liver have been studied at this hospital, except the 1 presumable case (cited earlier in the paper) which is not included in this series. In over 4,000 autopsies no case of traumatic cyst of the liver has been noted. Such cases, however, have been noted in the literature. Hawthorne, Oaks and Neese [15] reported a case which showed inspissated blood in the gallbladder at operation. The patient made an uneventful recovery, but continued to vomit blood for a short while after operation because blood had seeped down the biliary tract into the duodenum.

TABLE 7.—*Gross Pathologic Changes of Liver in Rupture*

Clinical Class	Lobe and Surface Involved	Type of Laceration
Massive hemorrhage.....	Right lobe	Split
Acute hemorrhage.....	Dome of right lobe	Extensive laceration
	Posterior aspect, right lobe	5 in. (13 cm.) deep
	Dome of right lobe	3 in. (7.6 cm.) deep
	Dome of right lobe	Several deep lacerations
	Dome of right lobe	3 in. deep
Repeated small hemorrhages	Right lobe	Split
	Posterior surface, right lobe	Large stellate laceration
	Posterior surface, right lobe	3 in. deep
	Posterior surface, right lobe	Large irregular laceration

In summation of our 10 uncomplicated cases, we found the following:

Massive hemorrhage.....	1 case
Acute hemorrhage.....	5 cases
Repeated small hemorrhages.....	4 cases

The greatest number of cases, therefore, fall into the group of acute hemorrhages or repeated small hemorrhages.

The pathologic changes in the liver are not characteristic, and the symptoms are not infrequently out of proportion to the pathologic changes (table 7).

DIAGNOSIS

The diagnosis of rupture of the liver without penetrating wound in the uncomplicated case is difficult, and it is extremely so in those cases in which severe complications occur. It must also be remembered that symptoms of intra-abdominal injury may not develop for six hours

15. Hawthorne, H. R.; Oaks, W. W., and Neese, P. A.: Liver Injuries with Case Report of Repeated Hemorrhages Through Biliary Ducts, Surgery **9**:358-360 (March) 1941.

or more.[16] There are no signs or symptoms which are pathognomonic of this condition, and one must evaluate each case on its own merit. The signs of rupture of the liver without penetrating wound are chiefly hemorrhage, shock and peritoneal and diaphragmatic irritation. In the rare case of subcapsular rupture, a tender mass may be palpable, as has been reported in the literature. In central rupture, blood—because of its entrance into the biliary tract—may appear in the vomitus, or the liver may become enlarged. However, because of the severity of the concealed hemorrhage it is essential that rupture of the liver be recognized early, so that proper treatment may be instituted without delay.

Abdominal pain is the commonest complaint. This pain is usually severe in character and worse on deep respiration and on moving. In all our cases, except in 8 in which the patients were unconscious or in profound shock, this symptom was either present at time of admission or it developed while the patient was under observation.

Radiation of the pain to the right or left shoulder (Kehr's sign) was not noted. McKnight[17] expressed the opinion that if the dome of the liver is involved pain is referred to the shoulder, and if the inferior surface is involved discomfort is referred to the waist line. Pain referred to the shoulder, if present, is helpful, but it is frequently absent. None of our patients had this pain.

Other symptoms of rupture of the liver are the symptoms of internal concealed hemorrhage.

Vomiting occurs not infrequently as a reaction to trauma. However, vomiting should be studied because in central rupture of the liver, blood may get into the biliary tree and appear in the vomitus.

The physical findings are more helpful. All cases in the group of massive hemorrhage and acute hemorrhage showed signs of shock. Those in the group of repeated small hemorrhages did not show these signs on admission, but as they were studied the fact of internal hemorrhage soon became evident. We, in our series, like Dean Lewis and I. R. Trimble,[18] did not observe bradycardia, which Finsterer and others[19] regarded as a characteristic symptom.

---

16. Butler, E.: Injuries of Chest and Abdomen, Surg., Gynec. & Obst. **66**: 448-453 (Feb.) 1938.

17. McKnight, R. B.: Postoperative Physiological Studies in Case of Traumatic Rupture of Liver, with Recovery, Am. J. Surg. **8**:542-547 (March) 1930.

18. Lewis, D., and Trimble, I. R.: Subcutaneous Injuries of Abdomen, Ann. Surg. **98**:685-697 (Oct.) 1933.

19. (*a*) McKnight.[17] (*b*) Finsterer, H.: Zur Diagnose und Therapie der Leberverletzungen, Beitr. z. klin. Chir. **119**:598-616, 1920. (*c*) Graham, A. J.: Subcutaneous Rupture of Liver, Ann. Surg. **86**:51-61 (July) 1927. (*d*) Orth, O.: Casuistischer und experimenteller Beitrag zur Leber- und Gallengangsruptur, Arch. f. klin. Chir. **101**:369-375, 1913. (*e*) Erdély, J.: Geheilte multiple Leberruptur nebst Darmverletzung: Beiträge zur Diagnostik und Therapie der subkutanen Leberruptur, Deutsche Ztschr. f. Chir. **198**:110-117, 1926.

The circulatory system showed the variations as noted in table 8. Seventy-two per cent of all patients entered the hospital with a systolic blood pressure below 90 mm. of mercury.

The location of site of maximum tenderness is misleading. In 1 case maximum tenderness was in the left upper quadrant, and diagnosis of ruptured spleen was made. The pathologic change found was rupture of the posterior surface of the right lobe of the liver. Table 9 shows the location of the pain and the physical findings of abdominal tenderness, rigidity and rebound tenderness.

Palpation of an abdominal mass in the hepatic area or an enlarged liver may be diagnostically helpful when present. Such masses are

TABLE 8.—*Blood Pressure in Rupture of Liver*

Blood Pressure on Admission	Lived	Died	Total	Percentage
Not obtainable	2	8	10	31.3
Systolic below 60	0	2	2	6.2
Systolic 60 to 90	0	11	11	34.4
Systolic 91 to 120	2	4	6	18.8
Systolic 121 to 140	2	0	2	6.3
Over 140	0	1	1	3.1

TABLE 9.—*Localization of Abdominal Pain, Tenderness, Rigidity and Rebound Tenderness in Hepatic Rupture*

Location	Pain	Tenderness	Rigidity	Rebound
Generalized	9	9	6	2
Upper part of abdomen	4	2	2	3
Lower part of abdomen	3	2	2	3
Right upper quadrant	2	3	4	3
Left upper quadrant	2	2	1	..
Right lower quadrant	3	3	1	..
Left lower quadrant	1	1	1	..

usually found in subcapsular or central rupture of the liver. Jaundice is rare but may appear in forty-eight to seventy-two hours after injury in some cases.

Laboratory studies, especially of the cellular elements and the hemoglobin content of the blood, are important; however, at times they may be misleading. Repeated blood cell counts and hematocrit determinations should be done in all cases until the diagnosis of some intra-abdominal injury is established. Hemoconcentration at first may conceal the fact of hemorrhage.

Examination of the urine should only be done to rule out pathologic changes of the urinary tract. If blood is found in the urine, it is wise to rule out other causes of concealed hemorrhage.

There are certain diagnostic procedures which may facilitate the diagnosis of rupture of the liver. Roentgenography may show a high diaphragm on the right side. Burke and Madigan reported the use of "thorotrast" (colloidal thorium dioxide) to outline the liver.[20] However, this method requires at least four hours and is of doubtful value.

The abdominal tap and peritoneoscopy are invaluable as aids in the diagnosis of rupture of abdominal viscera without penetrating wounds. The abdominal tap, performed with a spinal needle in all four abdominal quadrants, has in our hands been extremely helpful. In fact, we feel it is inexcusable to neglect to make an abdominal tap in all cases in which intra-abdominal injuries are suspected. This is especially true in cases in which associated lesions mask the abdominal complications. As was shown in our paper on ruptured spleen, the test is accurate. In our present series of rupture of the liver, the tap was employed in 15 cases and failed to disclose free blood in only 3 cases (table 4). The finding of blood by abdominal tap is indicative of intra-abdominal injury, whereas failure to find it does not rule out intra-abdominal injury. No "false positive" results were obtained. Peritoneoscopy was employed once, with a positive result.

Our experience with the abdominal tap has been satisfactory, and we do not hesitate to use it. It is especially helpful in cases in which the diagnosis is obscure, in cases in which the patient is admitted unconscious and in shock and in cases in which the physical signs are obscured either by fractured ribs or by concealed hemorrhage into cavities of the body other than the peritoneal.

The diagnosis of rupture of the liver without penetrating wound is not an easy one to make. When the history of trauma bears a direct relation to the chain of symptoms of abdominal pain and to the finding of abdominal tenderness and spasm with evidence of concealed hemorrhage, a presumptive diagnosis of ruptured liver may be made. The finding of a mass in the hepatic area or an enlarged liver is helpful but rare. Kehr's, Ballance's and Cullen's signs are helpful when present; their absence is of no significance. Bradycardia is significant when present, but is the exception rather than the rule.

First, it is important to rule out nonsurgical conditions.

There are many conditions which may obscure the diagnosis of rupture of the liver. Contusion of the abdominal wall gives a picture similar to that of rupture of the liver without penetrating wounds; however, in cases of contusion, the pulse rate, blood pressure and blood

20. Burke, W. F., and Madigan, J. P.: Roentgenologic Diagnosis of Rupture of Liver and Spleen as Visualized by Thorotrast, Radiology **21**:580-583 (Dec.) 1933.

cells are generally normal. The picture remains normal with abatement of the patient's symptoms.

Fractures of the ribs with shock due to hemorrhage into cavities other than the peritoneal cavity give a picture closely simulating ruptured liver. Here the abdominal tap is of inestimable value.

Once the diagnosis has placed a rupture of a solid viscus within the abdominal cavity the chances are equal of its being either spleen or liver, and not infrequently it is both.

In conclusion, we may say that the diagnosis of subcutaneous rupture of the liver is difficult because there is considerable variation in the clinical manifestation of this condition, owing to the character of the internal concealed hemorrhage which dominates the symptoms. In general the trauma which produces this condition is usually severe, causing other associated lesions which mask the rupture. The abdominal tap is an invaluable aid in the diagnosis of this condition and when the results are negative, it should be repeated.

TREATMENT

The treatment of traumatic rupture of the liver is surgical. Conservative treatment has been variously reported as fatal in 75 per cent to 96 per cent of the cases.[21] Operative intervention is imperative and delay increases the operative risk [22] and the probability of infection.

Preoperative treatment of this condition is directed to the establishment of an accurate diagnosis and to the combating of existing shock; in preparation of the patient for operation, the treatment must differ in individual cases. However, preoperative enemas are to be avoided for fear that the increase in intra-abdominal pressure due to straining at stool may destroy more hepatic tissue and increase the bleeding. Spinal anesthesia is avoided because there may be associated lesions of the intestinal tract.

Shock must be combated in the usual manner and large quantities of blood given before, during and after operation by the slow drip method. Autotransfusion has been recommended and used.[23] In fact, White [24] performed the first autotransfusion in this country and the

21. Ashhurst, A. P. C.: Surgery: Its Principles and Practice, ed. 4, Philadelphia, Lea & Febiger, 1931, p. 874. Deaver, J. B., and Ashhurst, A. P. C.: Surgery of Upper Abdomen, ed. 2, Philadelphia, P. Blakiston's Son & Co., 1921, p. 598.

22. Thöle, F., in von Bruns, P.: Neue deutsche Chirurgie, ed. 4, Stuttgart, Ferdinand Enke, 1912.

23. Watson, C. M., and Watson, J. R.: Autotransfusion: Review of American Literature with Report of Two Additional Cases, Am. J. Surg. **33**:232-237 (Aug.) 1936. Bloch, O. E.: Ruptured Liver with Recovery, Kentucky M. J. **28**:152-153 (March) 1930.

24. White, C. S.: Rupture of Liver, Surg., Gynec. & Obst. **36**:343-347 (March) 1923.

case was one of subcutaneous rupture of the liver. We do not use this procedure for two reasons: (1) the blood may be mixed with bile, and (2) it may contain toxins, the product of the autolysis of hepatic tissue.[18] Allen [25] reported a death by anuria fifty-six hours after autotransfusion in a case of ruptured liver.

Is exploration necessary in all cases of suspected hepatic injury? The answer is yes. There are three factors which must be considered; namely, bleeding, destruction of hepatic tissue and associated intra-abdominal injuries. Many surgeons have noted that by the time operation was performed, bleeding from the liver had ceased. Tellmanns [26] experimentally removed wedges of liver from animals without suturing the defect. The animals recovered. Therefore Hinton [27] advised that conservative treatment should be followed.

We cannot support this view, even though the bleeding may have a tendency to stop spontaneously in a few cases. The fact of a high mortality rate in conservative treatment cannot be denied. Thompson,[28] too, advised that conservative treatment should be followed.

In subcutaneous rupture of the liver, the biliary tree is also disturbed and considerable bile may be spilled into the abdominal cavity resulting in bile peritonitis. Pieces of hepatic tissue may be so damaged and its circulation so impaired as to result in necrosis. All damaged hepatic tissue must be removed, for Boyce and others [29] have expressed the opinion that a toxin is elaborated as a result of degeneration of hepatic tissue and that this toxin plays an important role in the so-called hepato-renal syndrome. Branch [30] reported 2 cases of rupture of the liver in which the patient made a good recovery in spite of a piece of necrotic liver not removed at the time of operation.

Should the patient be subjected to surgical treatment at once? Branch [30] stated the belief that "exploration should be undertaken in

---

25. Allen, A. W.: Internal Injuries Without Penetrating Wounds, New England J. Med. **205**:34-38 (July 2) 1931.

26. Tellmanns, H.: Experimentelle und anatomische Untersuchungen über Wunden der Leber und Niere: Ein Beitrag zur Lehre von der antiseptischen Wundheilung, Virchows Arch. f. path. Anat. **78**:437-474, 1879.

27. Hinton, J.: Injuries to Abdominal Viscera: Their Relative Frequency and Their Management, Ann. Surg. **90**:351-356 (Sept.) 1929.

28. Thompson, J. W.: Subcutaneous Injuries to Liver, Internat. J. Med. & Surg. **43**:540-543 (Oct.) 1930.

29. Boyce, F. F.: The Role of the Liver in Surgery, Springfield, Ill., Charles C Thomas, Publisher, 1941, p. 90. Boyce, F. F., and McFetridge, E. M.: Role of Liver Damage in Mortality of Surgical Diseases, South. M. J. **31**:35-39 (Jan.) 1938; Autolysis of Tissue in Vivo: Experimental Study with Its Clinical Application in Problem of Trauma to Liver, Arch. Surg. **34**:977-996 (June) 1937.

30. Branch, C. D.: Injury to Liver: Report of Two Cases, Ann. Surg. **107**: 475-477 (March) 1938.

every case of suspected liver injury in which the patient is not actually moribund, or in which he can be brought out of shock and rendered reasonably fit for exploration." Noble [31] stressed the importance of early diagnosis and expressed the belief that "surgery, done after development of symptoms secondary to rupture of the liver, is done too late." Cheyne and Burchard [32] stated the opinion that if "injury of the liver is severe, the patient will not recover from the primary shock until the hemorrhage is arrested and therefore operation is urgent."

We believe that to delay an operation, to pour blood into a person who is having a severe intra-abdominal hemorrhage, may gain little and may delay operation to such a point that no operative procedure can be carried out. We feel that exploration should be done as soon as the diagnosis is made, although supportive measures, such as slow drip transfusions of blood, intravenous administration of dextrose and isotonic solution of sodium chloride and blood plasma, are invaluable and should be begun simultaneously.

Early operation may also tend to eliminate complications such as infection, fatty embolism and hepatic tissue embolism.

In one of our cases, case 3 of table 4, the patient refused operation for eight days. At operation an extensive infection was found in the peritoneal cavity. Rutherford [33] reported a case of rupture of the liver in which there was no operation and in which a subdiaphragmatic abscess occurred one and one-half years after the injury.

Straus, Willer and Bauer [34] have reported cases of pulmonary embolism caused by hepatic tissue. Engel [35] has reported a case of fatty embolism following rupture of the liver.

Surgical treatment, then, is the treatment of choice, and it should be done early. There is a wide difference of opinion as to the surgical treatment of rupture of the liver. All methods deal with the control of bleeding, the repair of the defect and drainage.

---

31. Noble, T. B., Jr.: Traumatic Rupture of Liver in Children, Indianapolis M. J. **31**:91-94 (April) 1928.

32. Cheyne, W. W., and Burchard, F. F.: Manual of Surgical Treatment, London, Longmans, Green & Company, 1903, pt. 6, sect. 2, p. 107.

33. Rutherford, S. E.: Subdiaphragmatic Abscess One and One-Half Years After Laceration of Liver, Canad. M. A. J. **41**:489-490 (Nov.) 1939.

34. Straus, R.: Pulmonary Embolism Caused by Liver Tissue, Arch. Path. **33**:69-71 (Jan.) 1942. Willer, H.: Ueber Lebergewebsembolie und das gewebliche Verhalten aus dem Verbande gelöster Leberstücke in Organismus, Centralbl. f. allg. Path. u. path. Anat. **62**:209-213 (April 20) 1935.

35. Engel, H.: Fettembolie einer tuberkulösen Lunge in Folge von Leberruptur, München. med. Wchnschr. **48**:1046-1048 (June 25) 1901.

Steam [36] and cautery [37] have been used to control bleeding locally. Kocher [38] used compression clamps to crush the liver. These clamps were removed in twenty-four hours. For temporary control of hemorrhage, Pringle [39] advised digital compression at the foramen of Winslow, while Clementi and McDill [40] clamped the gastrohepatic omentum with an enterostomy clamp.

Large sutures have been used to control bleeding and repair defects in the liver.[41] In order to prevent sutures from tearing through the parenchyma, various types of decalcified bone plates,[42] free and attached omental strips [43] and fascial strips [44] have been used. Securing the liver to the abdominal wall in order to control hemorrhage has been advised.[45]

Various types of gauze packs, and packing with muscle, omentum, fat and rubber dam have been used. Halstead [46] advised a light drain or a small pack. Pilcher [47] stated that he hesitates to use large gauze packing because of a belief that this plays a role in the causation of intestinal obstruction. We feel that in simple tears when the liver is not badly lacerated suture may be done with safety.

---

36. Snegirew, W. F.: Der Dampf als blutstillendes Mittel, Deutsche med. Wchnschr. **20**:747 (Sept. 20) 1894.

37. Ullman, E.: Berichte aus den wissenschaftlichen Vereinen, Wien. med. Wchnschr. **47**:2244-2246 (Nov. 22) 1902.

38. Kocher, E. T.: Chirurgische Operationslehre, ed. 4, Jena, Gustav Fischer, 1902, p. 348.

39. Pringle, J. H.: Notes on the Arrest of Hepatic Hemorrhage Due to Trauma, Ann. Surg. **48**:541-549, 1908.

40. Clementi: Le ultime modificazioni nella cura della ferite, relative in especial modo al materiale per le legature dei vasi sanguigne ed alle forgnatura, Centralbl. f. Chir. **34**:651,655 (Aug. 23) 1890.

41. Kuznetsoff, M. M., and Pensky, I. P.: Étude cliniques et expérimentales, Rev. de chir., Paris **16**:501-521 and 952-992, 1896. Langenbuch, C.: Ein Fall von Resection eines links-seitigen Schnürlappens der Leber, Berl. klin. Wchnschr. **25**: 37-38 (Jan. 16) 1888. Cullen, T. S.: Surgery of the Liver, Surg., Gynec. & Obst. **4**:573-584 (May) 1907.

42. Ceccherelli, A., and Bianchi, A.: Nuovo processo di sutura per l'emostasi del fegato, Atti d. Cong. med internaz. sez. chir. (1894) **4**:188-191, 1895.

43. Boljarski, N.: Ueber Leberverletzungen in klinischer and experimenteller Hinsicht, unter besonderer Berücksichtigung der isolierten Netzplastik, Arch. f. klin. Chir. **23**:507-547, 1910.

44. Beck, C.: Surgery of the Liver, J. A. M. A. **38**:1063-1068 (April 26) 1902.

45. Chiari, O. M.: Zur Versorgung von durch stumpfe Gewalt entstandenen Leberwunden, Wien. klin. Wchnschr. **34**:460 (Sept. 22) 1921. Gillette, W. J.: Surgery of the Liver, Surg., Gynec. & Obst. **1**:361 (Oct.) 1905. Robertson.[14e]

46. Halstead, A. E.: Four Cases Requiring Liver Surgery, S. Clin. North America **3**:973-983 (Aug.) 1923.

47. Pilcher, L. S.: Massive Rupture of the Liver, Ann. Surg. **116**:827-832 (Dec.) 1942.

Recent work on the coagulum contact technic [48] of Sano and the use of fibrin foam, oxidized cellulose gauze or gelatin sponge "gelfoam" may not only be the best method of repairing the liver but also, because of the speed with which they can be used, may reduce the operating time and loss of blood and thereby reduce the mortality rate as well as the morbidity rate.

The prognosis for rupture of the liver depends not only on the severity of the rupture but also on the severity of the associated lesions. In the present series of 32 cases, 6 patients lived. The gross mortality was 81.3 per cent. The high mortality in this series was due to the large number of cases with serious associated lesions. Of the 26 patients who died, 11 died within the first four hours of hospitalization and without benefit of surgical treatment. Two patients died, one after nine hours

TABLE 10.—*Comparative Mortality Rates for Rupture of the Liver Without Reference to Associated Lesions*

Author	Number of Cases	Gross Mortality, Lived	Gross Mortality, Died	Gross Mortality, Percentage	No. of Cases with No Operation	Nonoperative Mortality, Lived	Nonoperative Mortality, Died	Nonoperative Mortality, Percentage	No. of Cases with Operation	Operative Mortality, Lived	Operative Mortality, Died	Operative Mortality, Percentage
O'Neill [7]	100	19	81	81.0	68	0	68	100.0	32	19	13	40.0
Thorlakson [3]	11	5	6	54.5	3	0	3	100.0	8	5	3	37.5
Lewis and Trimble [18]	20	8	12	60.0	6	0	5	100.0	14	8	6	40.0
Graham [19c]	11	6	5	45.4	2	0	2	100.0	9	6	3	25.3
Allen [25]	24	8	16	66.6	2	0	2	100.0	22	8	14	63.6
Hitzrot [12]	10	7	3	30.0	1	0	1	100.0	9	7	2	28.5
Lamb [8]	60	19	41	68.3	26	0	26	100.0	34	19	15	44.0
Wright, Prigot and Hill	32	6	26	81.3	17	0	17	100.0	15	6	9	60.0

in the hospital and the other after four days in the hospital. The diagnosis was missed because it was obscured by an associated laceration of the brain. One patient died on the way to the operating room twenty-seven hours after admission. Diagnosis was at first masked by symptoms from a lacerated brain. Two patients refused operation; 1 patient had bilateral fractured ribs.

Fifteen patients were operated on for rupture of the liver, and 9 died. Our operative mortality is therefore 60 per cent. Seventeen were not operated on, and all died. The causes of death in cases in which there was operation were as follows: Three patients died in shock; 2 died with generalized peritonitis—they had associated rupture of the gastrointestinal tract; 1 died of pneumonia; 1 had a severe laceration of the brain; in 1 infarction of the liver developed with jaundice; 1 died because a rupture of the spleen was missed at operation.

48. Sano, M. E., and Holland, C. A.: Coagulum-Contact Technic in Traumatic Rupture of Liver in Dog and Man, Science **98**:524 (Dec. 10) 1943.

Table 10 shows comparative gross mortality rates and operative mortality rates for cases of rupture of the liver. Operative mortality is dependent largely on the presence or absence of associated injuries and their character.

In our series in the 6 patients who lived, at operation the rupture of the liver was packed with gauze. Only 2 patients had associated injuries; 1 had a ruptured spleen, and splenectomy was done; the other had a fracture of the femur. The postoperative complications in this series were: purulent discharge around the gauze packing, in 3 cases, and decubitus ulcer, in 1 case.

We have had no cases with secondary hemorrhage from the packed liver as reported by Robin.[9] Clarke [49] reported a sequestrum of liver complicating recovery. McCorkle and Howard and others [50] reported hepatorenal syndrome complicating ruptured liver. In our series, none of the patients showed symptoms of hepatorenal syndrome, although 4 had infarction of the liver at necropsy; 2 had jaundice postoperatively, and 1 had free fragments of liver in the abdominal cavity at operation.

It is of interest to note that no patients in this series died a so-called liver death, while in a study [51] of gunshot wounds of the abdomen from this hospital, it was observed that of 16 patients with hepatic injury 3 died a so-called liver death, which is characterized by high temperature, falling blood pressure, circulatory collapse, coma and death; in such cases the loss of blood is insufficient to cause the symptoms.

In our cases in which there was recovery, morbidity was as follows: twenty-three, forty-four, thirty-one, ninety-eight, sixteen and twenty days. Gauze packing was removed on the fourteenth, the thirty-sixth, the twenty-third and the fortieth day; the day on which it was removed was not stated in 2 cases.

---

49. Clarke, R.: Case of Liver "Sequestrum" Complicating Subcutaneous Rupture of Liver, Brit. J. Surg. **28**:544-548 (April) 1941.

50. McCorkle, H., and Howard, F. S.: Severe Trauma to Liver with "Hepatorenal Syndrome," Ann. Surg. **116**:223-230 (Aug.) 1942. Furtwaengler, A.: Diffuse Rindennekrose beider Nieren nach Leberruptur: Ein Beitrag zu den angiosspastischen Krankheitsbildern in der Chirurgie, Krankheitsforschung **4**:349-374 (June) 1927. Stanton, E. M.: Immediate Causes of Death Following Operations on Gall Bladder and Ducts, Am. J. Surg. **8**:1026-1032 (May) 1930. Rosenbaum, J.: Ein Beitrag zum Problem des entero-hepato-renalen Syndroms (Anurie nach Leberschädigungen), Deutsche Ztschr. f. Chir. **243**:66-84, 1934. Helwig, F. C., and Schutz, C. B.: Futher Contribution to Liver-Kidney Syndrome, J. Lab. & Clin. Med. **21**:264-277 (Dec.) 1935. Becker, F.: Schwere Nierenschädigung nach Leberruptur, Zentralbl. f. Chir. **63**:674-677 (March 21) 1936. Orr, T. G., and Helwig, F. C.: Liver Trauma and Hepatorenal Syndrome, Ann. Surg. **110**:682-692 (Oct.) 1939.

51. Wilkinson, R. S.; Hill, L. M., and Wright, L. T.: Gunshot Wounds of the Abdomen: Review of One Hundred and Forty-Nine Cases, Surgery **19**:415-429 (March) 1946.

SUMMARY

Thirty-two cases of rupture of the liver without penetrating wounds are discussed, showing that they are neither rare nor infrequent. A classification based on the rate of hemorrhage is presented. The abdominal tap is an invaluable aid as a diagnostic procedure. Differential diagnosis must exclude lesions causing hemorrhage elsewhere in the body. Associated lesions may mask signs and symptoms of ruptured liver. Treatment of ruptured liver is surgical. The use of fibrin foam, oxidizable cellulose gauze or "gelfoam," which are the new methods for the control of hemorrhage, are worthy of extensive trial in these cases. Mortality, gross and operative, for subcutaneous rupture of the liver is discussed. Mortality can be reduced by: (*a*) early diagnosis so that immediate operation may be done; (*b*) the free use of blood, blood plasma and fluids in general to counteract coexisting hemorrhage and shock; (*c*) the use of penicillin and sulfonamide compounds to prevent infection, and (*d*) close teamwork on the part of the surgical and nursing staffs and by maintenance of a close watch over the patient throughout his hospital stay.

PARTIAL EXCISION OF THE MOTOR CORTEX IN TREATMENT OF JACKSONIAN CONVULSIONS

Results in Forty-One Cases

COBB PILCHER, M.D.

W. F. MEACHAM, M.D.
AND
T. J. HOLBROOK, M.D.
NASHVILLE, TENN.

> I believe that the only thing persistently physiologically abnormal in A. is that some few cells of his thumb-center have become fulminant. . . . It is a pity that A. cannot be rid of these worse than useless cells; but I know of no way of effecting this riddance. There is the surgical question of cutting out part of the cortex . . . —Hughlings Jackson,[1] 1890.

WITH the words quoted above, Hughlings Jackson, who twenty years earlier had described [2] the focal motor convulsive seizures which have subsequently borne his name, not only reemphasized the sharply localized origins of such attacks but boldly faced the possibility of surgical therapy in such cases.

After Jackson's original pronouncements, Horsley [3] and others had experimentally investigated the focal nature of convulsions and the physiologic effects of various cerebrosurgical procedures.[4] During the same period several surgeons carried out excisions of portions of the motor cortex because of focal epilepsy. The first was by Horsley [5] in 1886, and he subsequently reported 2 additional cases, in 1890.[6] Keen,[7]

From the Department of Surgery, Vanderbilt University School of Medicine. Some of the data and several of the cases on which this paper is based were presented before the Society of Neurological Surgeons, Nashville, April 18, 1946.

1. Jackson, J. H.: On Convulsive Seizures: The Lumleian Lectures, Brit. M. J. **1**:703, 1890.

2. Jackson, J. H.: Notes on the Physiology and Pathology of the Nervous System, M. Times & Gaz. **2**:481 (Oct. 23) 1869; Study of Convulsions, St. Andrews's M. Grad. A. Tr. **3**:162, 1870.

3. Horsley, V.: The Brown Lectures: Epilepsy, Lancet **2**:1211 (Dec. 25) 1886.

4. Horsley [3] was apparently the first to apply the term "jacksonian convulsions" to the local motor seizures described by Jackson.

5. Horsley, V.: Remarks on Ten Consecutive Cases of Operations upon the Brain and Cranial Cavity to Illustrate the Details and Safety of the Method Employed, Brit. M. J. **1**:863 (April 23) 1887.

(Footnotes continued on next page)

Nancrede [8] and Lloyd and Deaver [9] all reported cases in 1888. None of these cases was followed sufficiently long to justify conclusions regarding the convulsions, but it was observed in all cases that voluntary motion of considerable degree returned to the paralyzed parts. This was also true in Horsley's better known case of motor cortical excision for athetosis reported in 1909.[10]

In this connection, Gowers [11] wrote, in 1896, "If, indeed there is no evidence of removable disease, the excision of the centre, stimulation of which causes the movements with which the fits commence, may arrest them, and if the area excsied is not very extensive, the loss of power it causes soon lessens to a moderate degree, as Horsley and others have abundantly proved."

As neurosurgery developed, the suggestions of Jackson, Gowers and Horsley were generally ignored, and it was not until 1935 that Sachs [12] reported excision of the motor cortex in 11 patients, 8 of whom suffered from jacksonian fits. In 1938, Furlow,[13] from the same clinic, added 5 additional cases.

Foerster [14] evidently removed the motor cortex in a number of patients but did not cite individual cases. Putnam [15] and Bucy [16] have excised portions of the motor cortex for various types of involuntary movements, and in 1 case reported by the latter [17] the operation was

6. Horsley, V.: Remarks on the Surgery of the Central Nervous System, Brit. M. J. **2**:1286 (Dec. 6) 1890.

7. Keen, W. W.: Three Successful Cases of Cerebral Surgery, Am. J. M. Sc. **96**:329 (Oct.); 452 (Nov.) 1888.

8. Nancrede, C. B.: Two Successful Cases of Brain Surgery, M. News **53**: 584 (Nov. 24) 1888.

9. Lloyd, J. H., and Deaver, J. B.: A Case of Focal Epilepsy Successfully Treated by Trephining and Excision of the Motor Centres, Am. J. M. Sc. **96**:477 (Nov.) 1888.

10. Horsley, V.: The Linacre Lecture on the Function of the So-Called Motor Area of the Brain, Brit. M. J. **2**:125, 1909.

11. Gowers, W. R.: Manual for Diseases of the Nervous System, Philadelphia, P. Blakiston, Son & Co., 1896, vol. 2, p. 767.

12. Sachs, E.: The Subpial Resection of the Cortex in the Treatment of Jacksonian Epilepsy (Horsley Operation) with Observations on Areas 4 and 6, Brain **58**:492, 1935.

13. Furlow, L. T.: Subpial Resection of the Cortex for Focal Epilepsy, J. A. M. A. **111**:2092 (Dec. 3) 1938.

14. Foerster, O.: Motorische Felder und Bahnen, in Bumke, O., and Foerster, O.: Handbuch der Neurologie, Berlin, J. Springer, 1936, vol. 6, pp. 1-357.

15. Putnam, T. J.: Treatment of Unilateral Paralysis Agitans by Section of the Lateral Pyramidal Tract, Arch. Neurol. & Psychiat. **44**:950 (Nov.) 1940.

16. Bucy, P. C.: Effects of Extirpation in Man, in The Precentral Motor Cortex, Urbana, Ill., University of Illinois Press, 1944, p. 355.

17. Bucy, P. C.: Cortical Extirpation in the Treatment of Involuntary Movements, A. Research Nerv. & Ment. Dis., Proc. **21**:557, 1942.

performed for focal convulsions, with no recurrence of the attacks up to four years after operation.

During the past ten years, one of us (C. P.) has performed partial excision of the motor cortex on 41 patients who suffered from jacksonian convulsions.[18] It is the purpose of this paper to present the clinical results in this series. More detailed observations on the physiologic effects of cortical stimulation and of the operative procedure will be reported in another communication.

CLINICAL MATERIAL

All patients in this series have had focal cortical convulsions, none has had a gross cicatrix or a space-occupying lesion and all have been subjected to partial excision of the motor cortex.

The foci of origin of the seizures have been nearly equally distributed between the two sides, but attacks beginning in an upper extremity have predominated (table 1). This is not due to reluctance of the operator

TABLE 1.—*Primary Focus of Attacks*

Right side of face	1	Left side of face	2
Right arm	19	Left arm	15
Right leg	2	Left leg	2

to remove the face or leg areas but to an actually greater frequency of occurrence of attacks which begin in the upper extremity in our experience. It is true, however, that several patients whose attacks begin in the dominant side of the face (and have not been frequent or severe) have not been operated on.

The duration of the history of seizures was less than two years in only 8 of the 41 cases and was greater than five years in 17 cases. The frequency of attacks was naturally variable, but 17 patients had seizures which averaged not less than one per day. No patient was subjected to operation unless the duration and frequency of the attacks and failure to control them or difficulty of control by anticonvulsant drugs were thought to justify the presumption that they would continue to occur indefinitely.

Localizing electroencephalographic evidence corresponding to the pattern of the convulsions was present in many cases but lacking in others. There was no significant roentgenographic localization in any case (plain stereoscopic exposures were made in all cases, and pneumoencephalograms in approximately half of them).[19]

18. Eliminated from the series presented before the Society of Neurological Surgeons have been 5 cases in which there were grossly visible, although small and localized, scars. Several more recent cases have not been followed long enough to be included.

19. Obviously, many roentgenographically demonstrable scars, hematomas, tumors and congenital lesions which produced jacksonian seizures are not included in this series.

A severe preoperative paresis was present in only 1 patient in the series, but many patients had slight residual weakness in the parts primarily affected, particularly immediately after a series of severe seizures.

The patients were predominantly children or young adults: Eighteen were under 12 years of age, 20 were from 12 to 30 and only 3 were over 30. Seventeen were male and 24 were female.

TABLE 2.—*Duration of Follow-Up*

Duration	Number of Cases
1 to 2 years	7
2 to 3 years	10
3 to 6 years	15
More than 6 years	9

All cases have been followed in the postoperative period more than one year and more than half of them more than three years (table 2).

OPERATIVE PROCEDURE

All operations were carried out with the patient under local anesthesia, except those on small children, which were done with the patient under anesthesia with ether given intratracheally. Even in the latter cases, results of electrical stimulation were satisfactory in all except 1 instance (to be cited).

The same type of operation was carried out in all cases. An osteoplastic flap, designed to expose the motor cortex on the affected side, was reflected and the dura was incised in flap fashion, with the hinge of the flap toward the midline. The exposed cortex was inspected, palpated and sometimes explored with a ventricular cannula.

A map of the cortex was then made on sterilized cellophane, cortical markings being traced directly on the closely applied sheet of cellophane and points of subsequent stimulation being marked by numbers on the map with sterile pen and ink (fig. 1).

Electrical exploration was then carried out [20] by means of stimulation with a unipolar electrode employing a 60 cycle, 110 volt lighting current reduced by transformer to voltage of 0 to 8 volts. Stimulation was begun on the anterior lip of the central sulcus and was sometimes confined to this "strip." In many instances, however, more widespread electrical exploration was done. The desired area was localized in this manner in all cases but 1. On several occasions the patient's convulsions were reproduced by stimulation. In such instances a few drops of chloroform on gauze served to control the seizures promptly.

20. Dr. Sam L. Clark and Dr. James Ward furnished the stimulating apparatus and made detailed and accurate observations and notes on the patients during stimulation.

When the desired area had been identified, subpial resection of the cortex was carried out (fig. 2). The procedure was similar to the

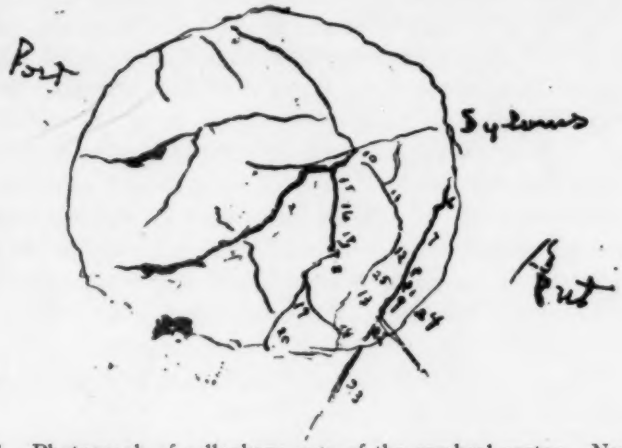

Fig. 1.—Photograph of cellophane map of the cerebral cortex. Numbers represent points of stimulation.

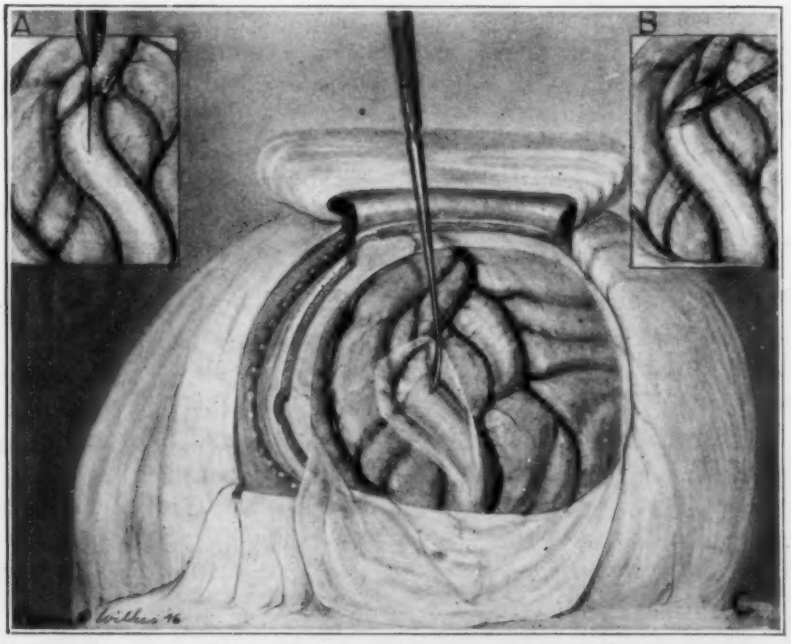

Fig. 2.—Subpial resection of the cortex. *A*, electrosurgical incision of the previously coagulated pia mater. *B*, reflection of the pia. *C*, removal of cortex to the depths of the sulcus by blunt dissection.

"Horsley operation" described by Sachs.[12] The pia mater in the center of the precentral convolution was coagulated longitudinally for the length

of the planned resection. This length usually extended slightly above and below the excitable area corresponding to the peripheral focus of origin of the patient's attacks. With the electrosurgical cutting current, the pia and superficial gray matter were incised. Resection of the cortex to the depth of the central sulcus was then carried out by blunt dissection, great care being taken to reach the pia of the anterior wall of the sulcus to its full depth. In most cases, the removal of tissue included, and was confined to, the precentral convolution for the variable supero-inferior lengths dictated by the pattern of the patient's convulsions and the results of stimulation. Removal of tissue in this way was necessarily piecemeal and often interfered with satisfactory microscopic study (this is discussed in the following section). There was no doubt, however, regarding the complete removal of the entire anterior wall of the central sulcus (as well as the adjacent portion of the precentral gyrus) for the desired length in all cases (excepting the single case in which no response to stimulation was obtained).

In 6 cases (in which focal sensory phenomena had been prominently present in the convulsions), the portion of the postcentral gyrus corresponding to the extent of the precentral excision was also removed in the same manner, the rolandic vessels being left intact.

The procedure of subpial resection is a relatively bloodless one and was chosen as that best suited to the welfare of the patient. No significant operative difficulty was encountered in any case.

TABLE 3.—*Results of Operation with Respect to Mortality*

Results	No. of Cases	Percentage
Postoperative deaths	2	4.87
Late deaths	3	7.31
7 weeks, pneumonia		
21 months, status epilepticus		
5 years, status epilepticus		
Alive today	36	87.8

The 2 operative deaths (table 3) which occurred in the series took place eight and nine days, respectively, after operation. The cause of death, as shown at necropsy, in the first was a pulmonary embolus, and in the second no complications of the operation were discovered and the cause of death is unknown.

GROSS AND MICROSCOPIC OBSERVATIONS

All cases in which there were gross cicatrices or space-consuming lesions have been eliminated from this series. At operation, the appearance of the brain was perfectly normal in 24 cases. In 17 there were visible arachnoidal thickening and grayish opacity or apparent shrinkage and atrophy of convolutions or both. These abnormalities were never confined to a single area, though on several occasions the operator

thought that they were most marked in the area subsequently proved to correspond with the focus of origin of the patient's attacks.

Microscopically, the tissue removed was normal in all respects in 14 cases. In 25 cases there was a distinct increase in glial elements (without definite glial scar in any case) and in 2 cases there was recognizable fibrosis in addition to gliosis.

From the standpoint of cortical architectonics, accurate determination of the extent of cortical excision was impossible because of the bit by bit method of removal of tissue. However, study of multiple sections of numerous blocks from each case, stained by the Nissl method, hematoxylin and eosin and other methods, has shown gigantopyramidal (Betz) cells in the majority of instances.

There can be little doubt that the tissue removed in each instance included the corresponding portion of area 4. It seems highly probable, however, that the excised areas also included whatever varying portions of the premotor cortex happened to lie in the precentral gyrus.

RESULTS OF STIMULATION

With the exception of a single case, the desired area of the motor cortex was located in all patients.

However, in addition to the anatomic localization thus obtained, two additional phenomena were observed in a number of instances, which added weight to the presumption of a hypersensitive cortical focus of origin of the patients' seizures.

The first was a differential hypersensitiveness in terms of voltage required to produce a motor response at the area in the motor cortex corresponding to the origin of the focal attacks. Thus, in a patient whose attacks began in the left hand, a current of 2 volts would produce (at a certain cortical point) motor responses in the left hand, whereas 4 or 5 volts might be necessary to induce responses (from their respective cortical areas) in the left leg or the left side of the face.

The second significant type of observation was the exact reproduction of the patient's seizure by stimulation of the appropriate cortical point with a current which produced only conventional local motor responses (or none at all) from adjacent portions of the motor cortex. This phenomenon was described by Nancrede [8] in 1888 and was observed in 12 of our cases.

POSTOPERATIVE RESULTS: PARALYTIC PHENOMENA

Immediately after operation, every patient (except the single one who failed to respond to stimulation [21]) showed a complete flaccid

21. This patient, a 3 year old child, had excision of the area presumed to be the motor facial area. Following operation, there was only slight facial weakness for three weeks, but there has been no return of convulsions in fourteen months.

paralysis of the affected part with absence of deep reflexes. In several instances of sharply localized attacks and correspondingly small areas of excision, this paralysis was confined to movements of the hand alone, but in most cases an entire extremity or side of the face was involved.

Hoffmann's sign, the sign of Babinski, forced grasping and other neurologic phenomena were variable in their appearance and will be discussed elsewhere. Spasticity accompanied by overactivity of the tendon reflexes did not develop in fewer than twelve days and, in most cases, was not observed until the patient's first return visit after discharge from the hospital—usually four to eight weeks after operation. Thus the exact time of its appearance was often uncertain. The subsequent degree of these abnormalities tended to parallel the motor weakness and recovery therefrom.

Within eight to twenty days after operation, voluntary motor recovery began in all cases. Gain in strength and in facility of movement and diminution in spasticity continued gradually for six to twelve

TABLE 4.—*Results of Operation with Respect to Disability*

Result	Number of Cases
No residual neurologic deficit	15
Mild residual weakness	17
Moderate residual weakness	3
Severe residual paralysis (present prior to operation)	1

months, but perceptible voluntary movements in all muscle groups had appeared in all patients in four to six weeks. In the upper extremity, flexor movements returned first and extension of the terminal phalanges of the fingers was the last movement to return. In the lower extremity, the calf muscles recovered before the anterior tibial group and extension of the toes was usually observed before flexion.

In only 1 patient (who had severe preoperative hemiparesis) has a marked degree of persistent weakness been observed. In 3 others moderate weakness of the affected extremity is apparently permanent. In 17 patients there is minor impairment of fine movements of the hand, slight spasticity of the fingers or a minor degree of weakness of the dorsiflexors of the foot. In the remaining 15 patients no demonstrable neurologic deficit is present. These patients play the piano, do needlework or perform comparable acts with the originally paralyzed muscles (table 4).

In the 6 patients who had postcentral (as well as precentral) cortical excisions, there was invariably a complaint of paresthesia ("numbness," "wooden arm," "rub my arm," "it feels like I'm going to have a spell") for three to ten days after operation. All 6 patients had diminution in (but not absence of) tactile and painful sensation in the affected extremity

which has persisted in 3 and disappeared after several months in the other 3. Astereognosis and loss of position sense were observed for seven and ten days, respectively, in 2 patients.

POSTOPERATIVE RESULTS: CONVULSIONS

All patients were given diphenylhydantoin sodium or phenobarbital for not less than one year after operation. Medication thereafter varied with the course of the individual patient.

The effects of the operation on the patients' convulsions are summarized in table 5. Eight patients (19.5 per cent) have had no seizures of any kind since operation. Of these, 2 had preoperative attacks several times daily, 3 had attacks more frequently than once weekly and 3 had attacks averaging two per month. The onset of attacks was two years or less prior to operation in 5 cases, but was more than seven years in the remaining 3. The ages of the patients were 18, 9, 18, 12, 19, 32, 8 and

TABLE 5.—*Results of Operation with Respect to Convulsions*

Results	No. of Cases	Percentage
No convulsions	8	19.5
More than 5 years	2	
More than 3 years	4	
More than 2 years	2	
Marked improvement	12	29.2
No attack past 5 years	3	
No attack past 3-5 years	1	
No attack past 1-3 years	2	
Infrequent attacks	6	
Improved	9	21.9
No improvement	8	19.5
Dead (with or without improvement)	5	12.1

22 years, respectively. These ages correspond approximately with the age distribution of the series as a whole. These 8 patients have returned to their normal occupation and consider themselves well.

Twelve patients (29.2 per cent) are classed as showing "marked improvement." Six of these had one or several seizures in the first postoperative week and have had none since. The remaining 6 are patients whose attacks occurred with great frequency prior to operation, but who have had only a few seizures at widely spaced intervals (greater than six months) since operation.

Nine patients (21.9 per cent) are classed as "improved" because of definite diminution in frequency and severity of attacks.

Eight patients (19.5 per cent) showed no sustained improvement, but none of them were classified as worse.

Of the 3 patients who died at a later time, 1 expired at home of pneumonia seven weeks after operation, having had no postoperative

convulsions.[22] A second had several severe postoperative attacks in a period of fifteen months, then had a symptom-free period of six months and finally died in status epilepticus twenty-one months after operation. The third showed no postoperative improvement and died in a convulsion five years after operation.

COMMENT

If one considers the distressing and disabling condition which is the subject of this paper, a condition usually considered to be irremediable, the results reported in our series must be regarded as highly encouraging. A procedure which in itself produces little or no permanent disability and the operative mortality rate of which has been less than 5 per cent has resulted in apparent cure or great improvement in 48.7 per cent of cases and in a lesser degree of improvement in an additional 21.9 per cent of cases.

Although all patients in our series had in common the occurrence of focal motor cortical seizures and the absence of space-consuming or grossly cicatricial lesions, there were several variable factors among them. Thus, the causation of the disorder has been variable, when known, and frequently unknown. Similarly, no microscopic abnormality was demonstrable in 14 cases, whereas the remainder showed variable degrees of glial proliferation and arachnoidal thickening. Analysis of available data has failed to reveal any significant relationship between history of injury or of encephalitis and the microscopic observations.

Further, neither of these factors can be statistically related to the effect of operation on the patients' convulsions.

Because of the method of excision employed, the precise amount of motor cortex removed cannot be stated, nor can the likelihood of inclusion in the excision of small portions of area 6 be denied. This renders evaluation of the postoperative neurologic picture difficult, and detailed discussion of this subject will be reserved for another report.

That removal of a portion of the motor cortex could be followed by excellent return of motor function was known to Horsley, Gowers and others, as already stated, but most neurosurgeons have treated this area with a healthy respect and few have hitherto made deliberate surgical attack on it. Thus Penfield and Erickson[23] stated in 1941, "The disability resulting from removal of motor arm area is so great that we have rarely touched the precentral gyrus and interference with the post-central gyrus is almost equally troublesome, because the hand becomes awkward and useless for delicate tasks." Our results show clearly, however, that such attack can be made with relative impunity,

22. This patient is *not* included in the "no convulsion" group.

23. Penfield, W., and Erickson, T. C.: Epilepsy and Cerebral Localization, Springfield, Ill., Charles C Thomas, Publisher, 1941.

but the mechanism of the return of function after motor cortical removal is by no means established and cannot be discussed here.

Our observations indicate that the occurrence of convulsions within the first few postoperative days is not necessarily of unfavorable prognostic significance. In 6 instances, such immediate postoperative seizures have been followed by complete freedom from attacks in the entire subsequent follow-up period, and in several other cases marked improvement has followed.

SUMMARY

In 41 patients with severe and frequent jacksonian convulsions but without space-consuming or gross cicatricial lesions, partial excision of the motor cortex has been carried out. No microscopic lesion was found in the tissue removed in 14 cases. Gliosis was present in the remainder.

There were 2 operative deaths. Gradual return of motor function with little or no disability occurred in all but 4 patients, who had moderate (3 patients) or severe (1 patient) hemiparesis.

Eight patients have been completely relieved of convulsions, 12 have shown pronounced improvement, 9 have been improved to a lesser degree, 8 have shown no improvement and 3 have subsequently died (1 of other cause).

It is believed that partial excision of the motor cortex has a place of real value in selected cases with focal motor convulsions.

NONDRAINAGE AND EARLY AMBULATION IN CASES OF PERFORATIVE APPENDICITIS

ARNOLD S. JACKSON, M.D.
MADISON, WIS.

THIS paper is a study of 15 cases of perforative appendicitis with peritonitis or abscess formation in which the appendix was removed, sulfathiazole was employed intraperitoneally, the incision was closed without drainage and spinal anesthesia and early ambulation were used. There were no deaths; a secondary intraperitoneal abscess requiring drainage occurred in 1 case. There were no other complications and no purulent wound infections. Penicillin was administered in the last 7 cases.

From this small series of cases the following conclusions have been deduced: Nondrainage in cases of perforative appendicitis with peritonitis is preferable to drainage. It is safe, and is desirable because it eliminates prolonged drainage and wound infection and minimizes the hazard of such postoperative sequelae as adhesions, hernia, fistula and obstruction. It shortens the stay in the hospital, saves dressings and bandages, lessens expense to the patient and lowers mortality. It is, moreover, impossible to drain the entire abdominal cavity.

The excellent results obtained with the intraperitoneal use of sulfathiazole over a period of five years confirm the experimental work of Throckmorton. He found that sulfathiazole is a specific against a large number of micro-organisms, that it is relatively innocuous to the peritoneum, that it has prolonged bacteriostatic effect and that it stimulates a local response similar to that in any other form of peritoneal medication.

Early ambulation in these cases of perforative appendicitis, despite ileus, peritonitis and fever, was found to be just as satisfactory and desirable as with other types of abdominal surgery. In like manner, the necessity for intravenous infusions, duodenal suction, catheterization and enemas was decreased.

Primary closure in cases of ruptured appendix is neither a new nor a radical procedure. Before the advent of the sulfonamide drugs or penicillin, several surgeons reported successful results with this method.

From the Jackson Clinic.

Read at the Fifty-Fourth Annual Meeting of the Western Surgical Association, Memphis, Tenn., Dec. 6, 1946.

Thus, Cottis and Ingham,[1] in 1935, reported a series of cases of localized and diffuse peritonitis, in 28 of which drainage was employed, with 9 deaths, and in 26 of which drainage was not employed, with 3 deaths, a mortality of 32.15 per cent in the cases with drainage and of 11.11 per cent in the cases without drainage. Cafritz[2] found that nondrainage resulted in less morbidity and less mortality; it minimized postoperative mechanical ileus, shortened the duration of illness, lessened the tendency to postoperative hernia, excluded the possiblity of development of fistula and minimized the tendency to postoperative adhesions. In 1939 Pickell[3] reported a series of 30 cases of spreading and generalized peritonitis, in only 1 of which a drain was used. There were 3 deaths.

In the same year Warren[4] compared results in a series of 91 cases with drainage and 25 similar cases without drainage. He concluded that a drain was the most important factor in the causation of fistula. In the entire series there was not a single case, with or without drainage, in which the wound did not show some evidence of infection; in 17.5 per cent of cases with drainage and in 60 per cent without drainage there was some evidence of secondary abscess formation. The author then studied a group of 25 cases of intestinal obstruction in the Peter Bent Brigham Hospital, 15 with drainage and 10 without drainage. The mortality for the 15 cases with drainage was 18.3 per cent, and for the 10 cases without drainage, 17.6 per cent.

In 1939 Collins[5] studied a series of 496 cases of perforated appendix with abscess formation in Los Angeles hospitals and concluded that spinal anesthesia was the safest of all types, resulting in a 12.6 per cent reduction in mortality over all other forms of anesthesia.

In 1944 Davison and Letton[6] reported that with the intraperitoneal use of the sulfonamide drugs they had lessened the average stay of the patient in the hospital almost six days.

Obviously, it is possible to review the literature only briefly, but from these reports it is apparent that the mortality rate for the cases without drainage was lower than that for the cases in which drainage was employed. However, even in the cases without drainage the mortality rates were from 11 to 17 per cent.

---

1. Cottis, G. W., and Ingham, H. W.: The Nondrainage Treatment of Peritonitis, New York State J. Med. **35**:49-55 (Jan. 15) 1935.

2. Cafritz, E. A.: Nondrainage of the Peritoneal Cavity in Appendiceal Peritonitis, J. A. M. A. **108**:1315-1317 (April 17) 1937.

3. Pickell, F. W.: Nondrainage in Complicated Appendicitis: Review of One Hundred and Nine Consecutive Cases, Surgery **5**:851-856 (June) 1939.

4. Warren, R.: Primary Closure of Peritoneum in Acute Appendicitis with Perforation: Report of Twenty Cases, Ann. Surg. **110**:222-230 (Aug.) 1939.

5. Collins, D. C.: Treatment of Complicated Acute Appendicitis with Particular Reference to Ochsner Method, M. Rec. **150**:127-129 (Aug. 16) 1939.

6. Davison, T. C., and Letton, A. H.: The Modern Treatment of Perforative Appendicitis, J. M. A. Georgia **33**:1-6 (Jan.) 1944.

Although there are only 15 cases in the series I am reporting, in which no drainage was employed, there were no deaths and only 1 case of secondary abscess formation. The better results in this series must, I believe, be attributed to the use of chemotherapy. All wounds were closed as with a nonperforated appendix, and only a "mediplast" dressing (an elastic adhesive bandage with a central gauze compress) was applied. This brings up a point for discussion, for Meyer [7] and Ochsner [8] and their associates have stated that it is imperative that drainage of the peritoneal wall be employed. This has proved unnecessary with the method which my colleagues and I have used since 1941, when we began to use intraperitoneally approximately 10 Gm. of sulfathiazole powder (not crystals) in ½ pint (250 cc.) of warm isotonic solution of sodium chloride. This is poured into the abdominal cavity, and the operating table is then tilted in all directions, so that the solution is carried from the diaphragm to the pelvis and from side to side. In closing the wound, no attempt is made to aspirate the solution, which is allowed to infiltrate the various layers. In addition, sulfathiazole powder is lightly dusted into all layers of the wound. The wound is closed with fine, interrupted and continuous, chromic surgical gut sutures. When we began to use early ambulation in these cases and in other cases of abdominal and pelvic surgery, fine tantulum wire was employed, but this has been given up. I am convinced that early ambulation, and not the type of incision or suture material, is the important factor in satisfactory wound healing. Employment of sulfathazole powder dusted lightly into all incisions for the past five years has virtually eliminated infections of wounds. Yet theoretic conclusions and reports based on laboratory studies to the contrary continue to appear in the literature.

Similarly, surgeons who have for so many years kept their patients in bed long after a major surgical procedure continue to warn against and argue about the hazards of early ambulation. At the 1941 meeting of this association, in discussing the paper by Drs. Counseller and McKinnon,[9] I stated that patients can, and will, be got out of bed as early as the third or fourth day and that, as a consequence, the incidence of thrombophlebitis and embolism will decrease. This statement was criticized as radical by some members. On the contrary, I now believe it to be too conservative. Experience has shown that in most cases of abdominal, thyroid and breast surgery the patient does better by being

7. Meyer, K. A.; Requarth, W. H., and Kozoll, D. D.: Progress in the Treatment of Acute Appendicitis, Am. J. Surg. **72**:830-840 (Dec.) 1946.

8. Ochsner, A., and Johnston, J. H.: Appendiceal Peritonitis, Surgery **17**: 873-892 (June) 1945.

9. Counseller, V. S., and McKinnon, D. A., Jr.: Factors Influencing the Incidence of Postoperative Thrombophlebitis in Gynecologic Surgery, Tr. West. S. A., 1941, pp. 456-475.

out of bed the first or second day unless he is in shock or threatened with hemorrhage. The only case in my service in the past two years in which an embolism occurred was a gynecologic case in which by mistake the patient was kept in bed three days. The use of heparin, dicumarol and oxygen enabled the patient to recover.

In 1920, when I was in the service of Dr. Henry Palmer, he impressed on me the harmful effects of keeping patients, particularly elderly ones, too long in bed. More and more I have come to appreciate the logic of his teaching. Early ambulation not only is conducive to speedy healing of the incision, by improving the circulation, but also reduces the necessity of catheterization, enemas, suction and intravenous therapy. Normal peristalsis is induced; the incidence of gas pains and ileus is minimized, and the patient is able to eat and enjoy food sooner. Atelectasis and pneumonia rarely occur any more.

One point concerning drainage is still debatable. Ochsner and Johnston [8] stated that it is now generally agreed that unless there is a localized abscess peritoneal drainage not only does no good but actually may be harmful. But in the case of a localized abscess he continues to use drainage, although he does not do so in a case of localized peritonitis. He also packs the wound with gauze and does not suture the skin, as is the method advocated by Gamble. In 8 cases in the present series abscess had formed and the wound was closed successfully without drainage; obviously, however, this is too small a series on which to have definite conclusions. However, I shall present a composite study of the views of 150 members of the Western Surgical Association with regard to drainage and chemotherapy from statistics compiled during the past four weeks.

Dees [10] probably was the first to use a sulfonamide drug intraperitoneally, and the Roosevelt Hospital group, in New York, popularized the method in 1941. They have always advocated the use of sulfanilamide locally. Early in our experience we discontinued the oral, subcutaneous and intravenous use of the sulfonamide compounds, believing the single large intraperitoneal dose to be the most effective.

When penicillin became available, it was employed in 30,000 unit doses every three hours, or in 300,000 unit doses in beeswax daily. Recently Crile [11] reported a series of 50 cases of proved peritonitis of appendical origin in which 100,000 units of penicillin was given intramuscularly every two hours for two to six days and but 1 death, from mesenteric thrombosis, occurred. In cases of spreading peritonitis the

10. Dees, J. G.: A Valuable Adjunct in Perforated Appendices, Mississippi Doctor **18**:215-217 (Sept.) 1940.

11. Crile, G., Jr.: Peritonitis of Appendiceal Origin Treated with Massive Doses of Penicillin: Report of Fifty Cases, Surg., Gynec. & Obst. **83**:145-208 (Aug.) 1946.

infection was controlled with penicillin. In no case was it necessary to drain an intraperitoneal abscess, and there was no spontaneous drainage into the bowel.

This report may revolutionize the treatment of peritonitis resulting from appendical perforation. It was not obvious to us that the additional use of penicillin materially altered the progress in our cases, and it had no apparent effect in the case of secondary abscess. However, the maximum dose of penicillin employed in our series was 300,000 units in twenty-four hours, in contrast to 1,200,000 units used in Dr. Crile's series. If any members of the association have had an opportunity to use penicillin in these larger doses, it should be reported in the discussion.

The problem of anesthesia seems to be largely a question of one's preference; however, having routinely used spinal anesthesia in abdominal surgery since 1928, I feel that it has definitely decreased the incidence of complications and has been a factor in the absence of deaths in this series.

Meyer and associates,[7] in a review of cases of appendicitis at Cook County Hospital, stated that in cases of appendectomy without drainage the mortality rate was much lower than in similar cases with drainage, that chemotherapy is largely responsible for the lowering of the mortality rate, from 26.4 to 13.9 per cent, and that spinal anesthesia is the method of choice.

That the problem of appendicitis has been of great interest to the members of this association is evident from a review of the *Transactions*. From 1891 to 1945 eighteen papers on various phases of the subject were presented. All of them reflect a realization of the seriousness of the disease, the unwarranted loss of life and the need of better methods of dealing with the problem. In the minds of some, appendicitis might appear as a lowly subject because of its common occurrence; despite all recent advances, however, the latest available statistics indicate that more than 8,000 persons died of appendicitis in this country in 1943. These statistics, of course, do not include the numerous deaths resulting from intestinal obstruction and other postoperative complications long delayed.

As Black [12] pointed out in his excellent presentation at the 1940 meeting of this association, men do not write papers on subjects which are generally accepted as settled. He noted 1,200 articles on various phases of appendicitis published in the two years preceding his paper.

In a previous paper read before the association in 1931, Black [13] presented an extensive statistical study on appendicitis compiled from the reports of 52 authors, covering the results of 1,500 surgeons working

12. Black, C. E.: Appendicitis, Tr. West. S. A., 1940, pp. 301-320.
13. Black, C. E.: Appendicitis Statistics, Tr. West. S. A., 1931, pp. 423-444.

at 150 hospitals. For the cases of suppurative appendicitis the combined mortality rate was 7.87 per cent; for the cases of gangrenous appendicitis, 8.73 per cent, and for the cases of spreading peritonitis, 21.19 per cent. The basic average mortality for all cases was 5.59 per cent. In discussing the number of days in the hospital following operation, Black cited a leading surgeon of his day, John Deaver, who mentioned periods varying from one to fifteen weeks.

We have come a long way from those figures of 1931; yet, unlike most surgical conditions, the mortality rate for appendicitis in this country rose steadily from 9.7 per cent per hundred thousand of population, in 1900, to 12.8 per cent, in 1936. Despite improved methods of medical teaching, developments in anesthesia, perfection of operative teamwork,

TABLE 1.—*Clinical Data on Fifteen Patients with Perforative Appendicitis Treated with Nondrainage and Early Ambulation*

Number of patients (8 males and 7 females)	15
Average age, years	38
Average stay in bed, days	2
Average stay in hospital, days	12
Secondary abscess	1
Purulent wound infection	1

TABLE 2.—*Value of Intraperitoneal Use of Sulfathiazole and Penicillin in Fifteen Cases of Perforative Appendicitis*

Chemotherapy used intraperitoneally	15
Sulfathiazole, Gm. in ½ pint of warm saline solution	10
Sulfathiazole used generally	8
Penicillin used generally *	7

* Average dose of penicillin, 300,000 units in twenty-four hours.

better and quicker methods of transportation and thousands of articles and lectures on the subject, both for the layman and for the members of the medical profession, 2 persons died of appendicitis every hour until the introduction of the sulfonamide drugs and of penicillin. These drugs have effected a great reduction in the death rate, from about 17,000 persons a year to approximately one-half that number. Yet half a million deaths from perforative appendicitis have occurred in this country in the past thirty years. The present death rate is still too high; if in all cases operation could be performed before perforation had occurred fully 98 per cent of the patients would recover.

In tables 1 and 2 the results of treatment in this series of cases are summarized.

Finally, a composite study of the views of 150 members of the Western Surgical Association on the principal points discussed in this

paper, namely, drainage and chemotherapy, is presented. When one considers the vast and important area in which the surgeons of this organization reside, extending, as it does, from Washington and Winnipeg, in the North, to Texas and Tennessee, in the South, and from Ohio and Michigan, in the East, to California, in the West, the influence of its members on the surgical decisions of others is of great moment.

One cannot say there is any uniformity of agreement on these important surgical considerations, or even that the views of the majority are necessarily correct. The ideas that I have expressed in this paper are largely those of the minority. I feel, however, that there is a growing tendency to support these views, namely, the value of nondrainage and local chemotherapy.

Replies to the questionnaire were received from 173 members; 23 were surgeons specializing in other fields or members who are no longer active. Thus, the replies of 150 were available for this study. Eighty-one members stated that they employed drainage; 38, that they do not use drainage; 17, that they rarely use drainage; 9, that they drain only if an abscess is present, and 5, that they drain only to the peritoneal wall. Sixty-nine are therefore opposed to drainage. Opinion, therefore, is fairly evenly divided on this subject. Several said, however, that they are beginning to abandon drainage.

As to the type of drain used, 76 stated that they favor the Penrose type, 12 the cigaret type, 14 a rubber tissue and 7 a rubber tube. Forty-two expressed no opinion.

Ninety stated that they favor the use of a sulfonamide drug within the peritoneal cavity and 60 that they oppose it; 47 use sulfanilamide, 35 sulfathiazole, 9 sulfadiazine and 1 succinylsulfathiazole. In addition to the local use in the peritoneal cavity, 93 stated that they favor the use of a sulfonamide drug by other methods and 43 that they oppose it, and 26 expressed no opinion.

Only 13 stated that they use penicillin within the peritoneal cavity; 137 had had no experience with this method. However, 119 were using penicillin by other methods; 26 expressed no opinion on this point, and 5 were using streptomycin.

REPORT OF SIX ILLUSTRATIVE CASES

CASE 1.—A man aged 33 probably had rupture of the appendix twenty-four hours before operation. A right rectus incision revealed a retrocecal, ruptured appendix with several ounces of pus and no walling off. Appendectomy was performed, base first. Twelve grams of sulfathiazole in isotonic solution of sodium chloride was used as a lavage in the peritoneal cavity. The patient was out of bed in twenty-four hours and walking to the toilet in forty-eight hours. Except for a slight serous discharge for two days, the wound healed perfectly, and the patient was dismissed on the twelfth day.

CASE 2.—A woman aged 28 had a gangrenous, perforated appendix with localized peritonitis. A pararectus incision was used. The appendix was about four times normal size with perforation near the tip and about 5 ounces (150 cc.) of foul pus. The pus was aspirated, and 10 Gm. of sulfathiazole in isotonic solution of sodium chloride was introduced. The patient was out of bed on the second day. The incision healed primarily, and she left the hospital on the ninth day after operation.

CASE 3.—A man aged 50 had a gangrenous appendix that had sloughed off at the base, and five interrupted silk sutures were required to close the perforation of the cecum. A pararectus incision was used. Ten grams of sulfathiazole in isotonic solution of sodium chloride was used as a lavage in the peritoneal cavity after aspiration of pus from the localized area of peritonitis. There was a slight serosanguineous discharge. The patient was discharged on the tenth day.

CASE 4.—A woman aged 53 had been ill ten days. A diagnosis was made of appendical abscess and obesity; she weighed 201 pounds (91.2 Kg.). This case presented an extremely difficult problem. A pararectus incision was used. The cecum and ascending colon were fixed in the region of the sigmoid, where a large appendical abscess was located. The appendix had sloughed off, and there were free fecaliths. The cecum was freed and restored to its normal location. The remnants of the appendix were removed. Because of the abnormal location of the abscess, there was much soiling of the lower part of the abdomen and the pelvis. Sulfathiazole was used as usual, and the abdomen was closed without drainage. Despite the obesity, only an elastic adhesive bandage with a gauze compress was applied, and the patient was up on the second day. However, duodenal suction and intravenous therapy had to be continued four days because of slight ileus. The wound healed primarily. The patient was discharged on the sixteenth day. Home conditions were such that she could not be discharged sooner.

CASE 5.—A man aged 55 probably had rupture of the appendix two days before operation, while he was driving from Chicago. A pararectus incision revealed a large, appendical abscess with almost complete obstruction of the bowel. The appendix had sloughed at the base, and free fecaliths were present. He was treated in the usual manner. Despite some degree of ileus and a temperature of 102 F., the patient was out of bed on the third day. Recovery was uneventful.

CASE 6.—A man aged 46 had a retrocecal appendical abscess of about one week's duration. About 3 ounces (90 cc.) of pus was aspirated; there were free fecaliths and a sloughing, gangrenous appendix with a slight perforation of the cecum. The patient received the usual treatment and penicillin therapy. Fever and some ileus prolonged recovery. The wound healed primarily, and he was discharged on the eighteenth day.

SUMMARY

A study is presented of 15 cases of perforated appendicitis with peritonitis or abscess formation in which the wound was closed without drainage.

The peritoneal cavity was lavaged in all cases with isotonic solution of sodium chloride containing approximately 10 Gm. of sulfathiazole.

There was 1 case of secondary abscess requiring drainage; otherwise there were no complications and no deaths.

Spinal anesthesia and early ambulation were used in all cases.

Penicillin, the dose not to exceed 300,000 units in twenty-four hours, has been used since it became available. Because successful results were obtained before its use, it is difficult to evaluate the worth of this drug. Possibly in much larger doses it may prove very efficacious.

The advantages of nondrainage, of chemotherapy and of early ambulation over methods formerly employed are evident.

A composite study of the opinions of 150 members of the Western Surgical Association on the problems of drainage and chemotherapy in cases of perforative appendicitis is presented.

This study shows that 81 members employ and 38 do not employ drainage, 18 rarely use a drain, 9 drain only if an abscess is present and 5 drain only to the peritoneal wall.

Ninety use a sulfonamide drug intraperitoneally; 60 oppose its use; 47 use sulfanilamide; 34, sulfathiazole; 9, sulfadiazine, and 1 succinylsulfathiazole.

Only 13 use penicillin intraperitoneally, but 119 use it in other ways; 5 use streptomycin.

DISCUSSION

DR. ROBERT L. SANDERS, Memphis, Tenn.: I feel that I should not take the floor again, though it is a pleasure to discuss Dr. Jackson's paper. He has brought up a good question.

All are familiar with Lawson Tait's statement, issued many years ago, "When in doubt, drain." Today, most surgeons reverse this: "When in doubt, don't drain." And rightly so in many cases, especially the type in which drainage was used formerly. For example, in removing a gallbladder, it is now known—that it seldom matters if one omits drains. A perforated appendix does not present the same situation, however; the cecum is full of virulent organisms, and bacterial peritonitis is far more likely to develop—in fact, is already present. I have made enough mistakes to be afraid to take a chance that a patient with a ruptured appendix will be able to resist the onslaught of so many of these organisms without the assistance of drains. The sulfonamide compounds are fine, but I do not trust them alone. Moreover, if one sprinkles a solution of sulfathiazole about the abdominal cavity, one is likely to scatter living organisms as well.

One should keep an open mind on this subject; but for the time being I shall confine the use of sulfathiazole to the infected area and shall continue to put in a drain or two.

DR. CUTHBERT POWELL, Denver: It is gratifying to me to see that Dr. Jackson has the courage to advocate closing the abdomen without drainage. It is also gratifying to me that he did not get the spanking I received, more than thirty years ago, before the first World War, in a paper which I read in Minneapolis before this society advocating nondrainage of the peritoneal cavity and showing that the peritoneal cavity could not be drained. I was spanked, and spanked properly. In fact, one of the older members got up, and I was fearful that he would have a cerebral hemorrhage. He said that any member of this society who would advocate such treatment did not deserve membership in the society.

I am still here, and I agree with Dr. Jackson that one cannot drain the peritoneal cavity. I started with nondrainage in gynecologic work, in cases of ruptured tubes and pus in the pelvis, and later treated appendicitis in the same way. During the war, I caught up with my good friend Dr. Leighton, of St. Louis, in an Army hospital, and he took me right up to operate on a man with appendicitis. I opened the abdomen and found an acute gangrenous appendix with localized peritonitis. I started to sew up the wound. Leighton was watching me; and, as I was putting in the sutures, he said, "Well, aren't you going to put in a drain?" I said, "If I do, he will die." He said, "If you don't, he will die."

I did not use a drain, and the man did not die.

DR. GORDON S. FAHRNI, Winnipeg, Manitoba, Canada: I am glad that Dr. Jackson has brought up the subject of early rising after an abdominal operation.

Few of us, I am sure, will question the statement that the integration of the principles of physical medicine with the postoperative management of patients has developed all too slowly.

Deep breathing exercises with planned movements of arms and legs ventilate the lungs, maintain muscular tone and stimulate the circulation, particularly the venous return. The simple regimen may be carried out easily with almost all bed patients who, for one reason or another, are unable to get out of bed or whose surgeons are apprehensive or disagree with the practice of early rising when possible.

The more ambitious practice of getting patients out of bed for short periods the first day or so after operation and increasing the ambulatory period each day is still more controversial. Nevertheless, surgical opinion on this continent in favor of early rising after abdominal operations is growing stronger and more widespread.

The patient is usually a bit apprehensive about getting out of bed the first or second day after an abdominal operation. A tactful nurse assists him to the sitting posture while the legs are rolled out; as the feet touch the floor, the patient's confidence returns, and each day thereafter his enthusiasm increases. This practice gives a sense of well-being that is most gratifying to the surgeon, and the patient's convalescence seems much more rapid. The common criticism is that wound healing may be retarded, predisposing to disruption of the wound or incisional hernia. The observations of many surgeons of considerable experience do not support this view.

Some of the more prominent benefits are the lowered incidence of pulmonary complications, such as atelectasis; the comparative freedom from ileus, and the speeding up of the venous blood return, which lessens the incidence of venous thrombosis and embolism. The less tangible benefits, such as a sense of well-being and the shortening of convalescence, are striking.

Each great war has taught much in the care of wounds, not the least of which has been an added appreciation of the value of integrating the principles of physical medicine with the surgical care of patients, as demonstrated particularly in World War II.

Before the close of the late war, all Canadian army hospitals, both at home and abroad, had their staffs of physical training instructors, and the nurses participated in the plan. It can be truly said that the surgeons of the Army, Navy and Air Force became alert to the benefits of physical medicine, some going to the point of getting patients who had had abdominal operations out of bed the first or second day. It is my feeling that the development of this aspect of surgery in civilian hospitals has been backward, and I welcome this opportunity to speak on

the subject before the members and guests of this association, in the hope of stimulating greater interest in the application of physical medicine to surgery.

DR. JAMES JACKSON, Madison, Wis.: I am Arnold's older brother, and if there is any spanking to be done it should be up to me to do it. Anyhow, as soon as I have made my remarks, I am leaving for the hill country in Arkansas to hunt quail, and he will have a difficult time in finding me.

All the Jackson brothers are individuals, and they never saw eye to eye on all subjects. Arnold got his early surgical training at Rochester, under careful supervision. Dr. Bob Sanders and I, on the other hand, got much of our early training operating in a farmhouse, on a kitchen table, boiling our instruments on the kitchen stove. When we removed a gangrenous ruptured appendix with abscess formation, we cleaned out the abscess and left a small drain down to the cavity. If there was pus in the pelvis, we inserted a cigaret drain down to the bottom of the pelvis. I continue to use this procedure today.

As to the question of flooding the peritoneal cavity with a solution of a drug such as one of sulfathiazole, there may have been a little misunderstanding as to the type of case in which Arnold meant to use this measure. He was referring to cases of generalized peritonitis, in which the pus has already spread to most of the abdomen, and not to a localized pocket. In the old days, when my brother, Dr. Reginald, or I had one of these cases, we used to flush out the peritoneal cavity with a quantity of saline solution, tilting the table and in that way diluting the pus and doing a good job of washing out the cavity. Miraculously, some of our patients got well. Of course, this would not be done with a localized abscess.

Arnold uses a drain in a case of clean gallbladder but closes up the wound in cases of abscessed appendix. I have done some 500 cholocystectomies without putting in a drain, but I usually use a drain in a case of appendical abscess.

I agree with everything that Arnold said about spinal anesthesia and early ambulation.

DR. ARNOLD S. JACKSON: I can see that this discussion is rapidly degenerating into a family feud. A neighbor just leaned over and said "How old is Jim?" I said, "Oh, about 64. He is old enough to know better, anyway."

I selected this title because it has seemed to me that recently our meetings are getting pretty tame. We lack the gnashing of teeth and the pulling of hair we used to have with good old Leonard Freeman, Donald McKraig, Jabez Jackson and others, who used to make our discussions really worth while. I do not have any apologies for my subject and I thank Bob Sanders for his excellent discussion. I purposely picked out Bob. I knew his views were the opposite of mine and that they would represent the opinions of the majority. However, the views of the majority cannot always be correct, and the fact that the questionnaire showed that opinion on the question of drainage is pretty evenly divided is something for every one to consider.

As for Bob, he is one of my best friends, as he has said; a few years ago Bob came up North to see how we were doing this operation. I tried to sell him on the idea of spinal anesthesia, but it was no use. Those of you who were at the meeting yesterday heard Bob say, "Well, spinal anesthesia is pretty fine; I am using it." So Bob will change his ways. Give him time!

(Slide) Jim cleared up one point in the treatment of the localized abscess. I did not mean to imply that the peritoneal cavity is flooded with staphylococci and other dangerous organisms. In cases of localized abscess, sulfathiazole is applied locally, but in the cases of peritonitis the entire peritoneal cavity is

irrigated with 12 Gm. of the drug in saline solution. No one mentioned the use of very large doses of penicillin, but I noticed that the last group of letters I received were influenced by the recent article of Crile's on this point.

The only way to ascertain the facts is to try this method and see for yourself. I do not want any more of those dirty, purulent wounds that used to take so long to dress and care for. Nondrainage eliminates that sequela, as well as many others.

You all agree that Al Ochsner is a pretty good surgeon. He says that drainage of the peritoneal cavity for peritonitis not only does no good, but actually may be harmful. All highly respect the opinion of Karl Meyer, and he does not drain the peritoneal cavity in cases of peritonitis.

ISOLATED PARALYSIS OF THE SERRATUS MAGNUS FOLLOWING SURGICAL PROCEDURES

Report of a Case

PAUL H. LORHAN, M.D.
KANSAS CITY, KAN.

PARALYSIS of the serratus magnus muscle following surgical treatment probably occurs more frequently than is usually suspected. Cotton and Allen [1] reported 30 cases of peripheral paralysis in a review of the literature up to 1903. No other cases appeared in the literature until 1926, when Thorek [2] cited a case which he saw that year. The scarcity of reports since 1926 is remarkable.

Of the muscles supplied by the brachial plexus, the serratus magnus, by its anatomy and nerve supply, is most logically susceptible to isolated paralysis. The muscle is generally described as being formed of three parts: The upper part originates from the first two ribs and from a fibrous arch uniting these two attachments, and is inserted on the costal surface of the scapula near its medial angle. The middle part arises from the second, third and sometimes the fourth ribs, and spreads out into a thin sheet which is inserted along the vertebral border of the scapula. The lower part, which is the strongest, takes its origin by digitations from the fourth to the eighth or ninth rib and is inserted on the costal surface of the scapula near its inferior angle.

The long thoracic nerve, on which the serratus magnus muscle is almost entirely dependent for its innervation, was described by Morris [3] as arising from the fifth, sixth and seventh cervical nerves. Horowitz and Tocantins [4] found that the eighth cervical nerve also takes a part in the formation of the long thoracic nerve in some cases. The nerve trunk passes dorsal to the clavicle at the junction of its middle and outer thirds, then downward and laterally beneath the brachial plexus

From the Department of Anesthesiology, Hixon Laboratory for Medical Research, University of Kansas Hospitals.

1. Cotton, F. J., and Allen, S. W.: Brachial Paralysis, Postnarcotic, Boston M. & S. J. **148**:499 (May 7) 1903.

2. Thorek, M.: Compression Paralysis of the Long Thoracic Nerve Following an Abdominal Operation, Am. J. Surg. **40**:26 (Feb.) 1926.

3. Morris, H.: Human Anatomy, Philadelphia, P. Blakiston's Son & Co., 1933.

4. Horowitz, M. T., and Tocantins, L. M.: Anatomical Study of the Role of the Long Thoracic Nerve and the Related Scapular Bursae in the Pathogenesis of Local Paralysis of the Serratus Anterior, Anat. Rec. **71**:375 (Aug. 25) 1938.

and lateral to the axillary vessels and extends beneath the scapula and along the anterior border of the latissimus dorsi. Twigs are furnished to the superior portion of the serratus magnus by the two upper roots as it runs along the axillary border of that muscle, and farther down the nerve supplies each digitation of the serratus magnus muscle.

In spite of these factors which appear to favor limitation of a paralysis to the serratus magnus, reports of such cases are rare as compared with the number of cases of paralysis affecting the entire brachial plexus. Especially rare is the appearance of isolated paralysis of the serratus magnus following operation, as I have found only 8 cases in the literature.

The etiologic factors most commonly mentioned are infection and trauma, the latter including overexertion, working with the arm above the head, carrying heavy weights and direct blows to the muscle or the nerve. Causes less often ascribed include exposure to cold, compression of the nerve roots by osteoarthritic deposits in the intervertebral foramens, inflammation of the subcoracoid and subscapular bursas, pressure by a cervical rib, toxic neuritis produced by the anesthetic and compression of the nerve as it passes through the scalenus medius muscle. Berkheiser and Shapiro [5] stated the belief that concussion is the etiologic factor. Horowitz and Tocantins [6] expressed the opinion that morphologic variations in the formation and distribution of the long thoracic nerve are influential and explain why identical traumas in different persons only infrequently result in this type of lesion. Brickner [7] cited Verhoogen and Casse that a specific action of the anesthetic (chloroform) might be a causative factor in the production of a toxic neuritis, but this opinion is refuted by the experience of other observers.

Cotton and Allen [1] ascribed the paralysis solely to abduction of the arms drawn up over the head during anesthesia. Brickner,[7] furthermore, cited Sehrwald as stating that paralysis of the long thoracic nerve occurs by bruising of the brachial plexus between the clavicle and scalenus medius after operation in those cases in which the arm is hyperabducted.

Ellis [8] concluded in his report that paralysis of the serratus magnus is much commoner in men than in women. Mullen [9] stated that injuries

5. Berkheiser, E. J., and Shapiro, F.: Alar Scapula, J. A. M. A. **108**:1790 (May 22) 1937.

6. Horowitz, M. T., and Tocantins, L. M.: Isolated Paralysis of the Serratus Anterior Muscle, J. Bone & Joint Surg. **20**:720 (July) 1938.

7. Brickner, W.: Peripheral "Anesthesia Paralysis": Report of Unusual Case of Bilateral Paralysis Occurring During Narcosis, New York M. J. **73**:722 (April 27) 1901.

8. Ellis, J. D.: Delayed Traumatic Serratus Paralysis, Arch. Neurol. & Psychiat. **22**:1233 (Dec.) 1929.

9. Mullen, T. F.: Safeguarding the Unconscious Operative Patient, West. J. Surg. **46**:678 (Dec.) 1939.

of the brachial plexus during operation are much commoner in women and usually follow some pelvic operation.

At this time I should like to present a case of postoperative paralysis of the serratus magnus muscle, which responded successfully to treatment.

REPORT OF A CASE

A young white woman in good physical condition was operated on under nitrous-oxide-oxygen-ether anesthesia, the McKesson machine being used. The operation consisted of appendectomy, uterine suspension, myomectomy and ligation of varicosities in the broad ligaments. The patient was placed in a 35 degree Trendelenburg position and supported by shoulder braces covered with rubber pads. The operation required one hour. The patient was awake within forty minutes after returning to her room. Two days after the operation, the patient first complained of pain in her left shoulder. On the seventh postoperative day, she awakened suddenly in the morning with a severe pain in her right arm. The next day she felt sore across her shoulders, but had no complaints referable to the arm. Ten days after the operation the right arm was sore, and the pain became severe two days later. At this time a hot pad was applied to the arm and oil rubs were given, with some relief. The patient was discharged on the thirteenth day after the operation with no complaint except a soreness of the right arm. One week later she noticed a deformity of the right shoulder region and returned for examination. During this examination, tenderness was noted anterior to the trapezius muscle and over the brachial plexus and a pronounced deformity of the right scapula. A diagnosis of winged scapula was made. Roentgenograms of bony structure revealed no abnormality. The patient received galvanic interrupted treatment of 1 to 2 amperes over the course of the long thoracic nerve lasting for five minutes, and therapy with infra-red rays and massage twice a week for approximately a year. At this time the condition has cleared up and a slight deformity is present. She is able to move her arm without discomfort.

The action of the serratus magnus muscle is to hold the scapula against the thorax and to draw it forward and laterally; by its highly developed inferior portion it rotates the bone so as to raise the point of the shoulder. It is of special importance in abduction of the arm and also aids to a slight extent in forced respiration. From these facts may be inferred the signs and symptoms of paralysis of the serratus magnus muscle. The patient is unable to raise the arm above the horizontal, and when he attempts to do this the median border of the scapula approaches the vertebral column. When the arm is held horizontally forward, the median border and the inferior angle of the scapula are removed from the thorax and the scapula stands off like a wing; this leaves between the scapula and the chest wall an excavation into which the entire hand may be introduced. There is weakness of the arm and the patient is unable to cross the arms anteriorly. There is also difficulty in performing pushing movements or exerting pressure.

The onset of paralysis is often preceded by sudden severe pain in the supraclavicular fossa or shoulder, radiating to ear, occiput, scapular region or arm, which may persist.

Treatment of isolated paralysis of the serratus magnus muscle is according to the following plan: 1. Focal infection, postural compression and occupational factors must be treated or eliminated. Treatment includes braces, physical therapy, massage, electrical stimulation and guided exercises. Slow surging sinusoidal current is applied so that only three complete phases of current stimulate the muscle daily. 2. The arm is immobilized, the elbow being brought sharply across the chest with the forearm flexed and supinated. 3. There is operative intervention by transplantation of the latissimus dorsi over the inferior angle of the scapula or transplantation of the clavicular origin of the pectoralis to the serratus magnus or the axillary border of the scapula.

Prognosis is dependent on the degree of injury sustained. Potts [10] stated that prognosis for recovery was bad. Most authors, however, have expressed the view that complete recovery is the usual outcome, but it requires from three months to a year.

Prevention of postoperative paralysis is an important problem. The anesthesiologist should see that the patient is made as comfortable as possible before rendering him unconscious. This is accomplished by adjusting the arms properly at the patient's side, not allowing them to hang over the side of the table. When the Trendelenburg position is to be assumed the shoulder rests should be adjusted laterally and away from the brachial plexus. They should be properly padded so that they do not cause compression on the nerves. Removing the unconscious patient from the operating table to the transportation cart and from there into bed requires diligent care and handling. The neck should not be hyperextended during the moving nor should the arms be twisted in any manner whatever, as traction on the arms may cause tearing of nerves from the brachial plexus.

The beginner in anesthesia should not be overzealous in his attempts to prevent the jaw from dropping by placing his fingers too firmly along the neck to give a strong brace; by doing so one or more of the fingers may press on the fifth, sixth and seventh cervical nerves near their exit between the scaleni, and, as is frequently the case, the head is violently rotated to one side and the nerve or nerves may be compressed between the fingers and the vertebrae.

---

10. Potts, C. S.: Isolated Paralysis of the Serratus Magnus: Report of a Case, Arch. Neurol. & Psychiat. **20**:184 (July) 1928.

PROGRESS IN ORTHOPEDIC SURGERY FOR 1945

A Review Prepared by an Editorial Board of the American Academy of Orthopaedic Surgeons

XV. FRACTURE DEFORMITIES

Prepared by

LEONARD T. PETERSON, M.D., WASHINGTON, D.C.

(Continued from Page 612)

Principles.—Smillie [578] introduces his discussion of the stiff knee in fracture of the femoral shaft with a comment on the complex development of this joint. He attributes stiffness to adhesions in the joint, in the capsule or in the quadriceps, and states that powerful traction is the most important contributory factor. He condemns the use of skeletal traction for reduction, feeling that it should really be used only for maintaining reduction. He does not approve the use of skeletal traction for more than three weeks. If traction is absolutely necessary through the condyles he prefers a Steinmann pin to a Kirschner wire because it causes less reaction and because it is driven in and fits tighter. Actually he prefers skeletal traction through the upper part of the tibia. [ED. NOTE.—Even the Steinmann pin should have a drill point of a cutting or "bayonet" type and should be drilled. The superiority of pins over wires in regard to reaction is not confirmed by my personal observations.] His points on surgical approach, fixation material and methods of grafting are well stated. [ED. NOTE.—On page 321 he states "only non-toxic stainless steel should be used," and on page 322, "better to make the . . . decision to carry out . . . insertion of vitallium plate . . ." Stainless steel and vitallium are quite different in composition and physical properties and obviously should not be mixed.] A supracondylar fracture he reduces manually and holds by 5 to 10 pounds (2.3 to 4.5 Kg.) skeletal traction through the tibial tubercle with angle of the Braun splint at the fracture site instead of at the knee. He changes to cutaneous traction and Thomas splint in eight weeks and makes an excellent point of keeping the knee straight for early exercise of the quadriceps. Fractures in the midshaft also are reduced manually and held by 5 to 10 pounds of cutaneous traction. If this is unsuccessful open reduction should be performed in a week. [ED. NOTE. (L. D. B.).—One of the editors feels that there is seldom need for open reduction of fractures of the midshaft of the femur. This

578. Smillie, I. S.: The Problem of the Stiff Knee Joint in Fracture of the Shaft of the Femur, Edinburgh M. J. **52**:317-328 (Sept.) 1945

bone has remarkable reparative ability.] He prefers open reduction for displaced fractures of the upper third of the femur. He discusses rehabilitation measures, manipulation and surgical treatment for release of adhesions in and above the joint. [ED. NOTE.—This is an excellent article on the subject.]

Greenberg and Mohamed [579] endeavored to delay healing in the fractured fibula of rats by partial constriction of the femoral artery, using the normal side for control. The breaking strength was found to be from five to ten times greater on the normal side after intervals of from six to thirty days. Dextrose-1-phosphate administered subcutaneously had no favorable effect on healing the fractures as compared to inorganic phosphate, which was used as a control.

Habbe and Wright [580] emphasize the importance of careful diagnosis, especially when the presence of a fracture may be overlooked because of more serious injuries elsewhere. While fractures may be missed in any region, particular attention is called to the carpal navicular fractures and fractures of ribs and vertebrae. [ED. NOTE.—This article reaffirms well known principles.]

Harmon [581] describes a posterolateral approach to the tibia and the fibula. This offers a wide exposure of the middle three fifths of the tibia suitable for bone grafting and for synostosis operation. [ED. NOTE. —This brief article is well illustrated and is an excellent description of an incision which is valuable in selected cases.]

Webster [582] reports on the treatment of scars following war injuries of the leg. Skin-grafting methods include (1) double end sliding flap; (2) single end local sliding flap; (3) direct pedicle flap from the other leg—"delayed" shifting of the flap is not considered necessary in the latter, and (4) intermediate flaps from a distance. [ED. NOTE.—This article is a brief statement of methods of skin grafting for lesions on the leg.]

Somervell [583] discusses the treatment of old neglected fractures which he encountered in missionary work in India over a period of twenty-five years. He summarizes briefly the physiology of formation of callus and the principles of immobilization. For a shortened ulna he recom-

---

579. Greenberg, D. M., and Mohamed, M. S.: Effect of Lowered Blood Supply and of Glucose-l-Phosphate on Healing of Fractures, Proc. Soc. Exper. Biol. & Med. **57**:203-205 (Nov.) 1944.

580. Habbe, J. E., and Wright, H. H.: Evidence of Old Forgotten or Previously Undiagnosed Fractures, Radiology **43**:531-547 (Dec.) 1944.

581. Harmon, P. H.: A Simplified Approach to the Posterior Tibia for Bone Grafting and Fibular Transference, J. Bone & Joint Surg. **27**:496-498 (July) 1945.

582. Webster, G. V.: The Scar Problem in Compound Injuries of Lower Leg, Stanford M. Bull. **3**:109-113 (Aug.) 1945.

583. Somervell, T. H.: Malunited and Ununited Fractures, J. Christian M. A. **20**:27-30 (March) 1945.

mends excision of the radial head to relieve pressure on the capitellum. For a shortened radius he step cuts the ulna and shortens it. [Ed. Note.—When the inferior radioulnar joint is disturbed, resection of the lower end is preferred.] When the fibula is disproportionately long after fracture of the tibia only, the former is shortened. [Ed. Note.—This article is a brief discussion of impressions and includes several reports of cases on a few related conditions.]

Nonunion.—Boyd [584] reports over 90 per cent successful results in 575 cases of bone graft for nonunion of the shaft of long bones. He reviews the important diagnostic points as well as the operative technic using massive onlay grafts fixed with four or more metal screws. He does not recommend grafting until several months after infection is cured. In applying the graft, the endosteal bone is cut from the cortex of the graft. [Ed. Note.—Since the endosteal bone is then added it would appear desirable to leave it on the graft except when removal is necessary for proper fit.] The advantages of dual grafts in congenital pseudarthrosis and other difficult nonunions are outlined. - Fibular grafts are recommended for defects of the humerus.

Fett, Foote, and Stevens,[585] reporting on delayed union and nonunion in the Navy, state that they use drilling to stimulate union in cases with delayed union. They classify nonunion as (1) pseudarthrosis, (2) fibrous union with osteoporosis and (3) fibrous union with atrophy of tissue. The causation is discussed and the importance of infection and of lack of immobilization is rightfully emphasized. Standard methods of bone grafting are discussed, including thin grafts of cortex and periosteum, especially for the forearm. [Ed. Note.—The medulla of onlay grafts is cut down with a motor saw, whereas it seems well to leave this on for firm contact with the host.] The use of primary bone grafts is mentioned, and 1 case is reported of its use in a spiral fracture of the tibia. [Ed. Note.—This fracture does well on primary open reduction and fixation with screws but rarely needs a graft if treated in this manner. Commoner sites such as transverse fracture of the upper ulna, of both forearm bones and of the femur deserve consideration of primary grafting.] [Ed. Note (L. D. B.).—In most cases this fracture does well with a self traction cast, flexed knee and dorsiflexed ankle, plus time, and rarely needs screws or grafts.] They routinely use sulfathiazole locally [Ed. Note.—of doubtful value.] and penicillin, in both clean and previously infected fractures, postoperatively, and report low incidence of infection but give no statistics. Complications include infection, fracture of graft and fracture of donor site.

584. Boyd, H. B.: The Treatment of Ununited Fractures, M. Press **213**:116-119 (Feb. 21) 1945.

585. Fett, H. C.; Foote, R. F., and Stevens, M. A. L.: The Problem of Delayed Union and Nonunion of Fractures, Am. J. Surg. **69**:283-298 (Sept.) 1945.

[ED. NOTE.—Reference is made to vitallium screws only, and fractured screws appear in several illustrations. This emphasizes the need for screws of adequate strength and constant physical characteristics.]

Horwitz and Lambert [586] advocate the use of iliac bone in conjunction with internal fixation in treatment of nonunion, feeling that the osteogenetic quality of iliac bone more than compensates for the lack of rigidity, the latter being furnished by a plate. Furthermore, use of iliac bone avoids the danger of tibial fracture, which is not uncommon when tibial graft is used. They have obtained iliac grafts as large as 25 by 12.5 cm. (1 by 5 inches). In compound fractures a period of six months elapsed before use of this method. Their grafts were combined intramedullary, inlay and onlay in most cases. In some of the cases plates which had been inserted earlier were left in place and the grafts were added with fixation by screws. The authors used only suspension and skeletal traction postoperatively, changing to cutaneous traction after ten weeks. Sixteen cases were reported, 10 involving the femur, 4 both bones of the forearm and 2 the tibia. [ED. NOTE.—This paper confirms the value of iliac bone for grafting and the benefit of firm internal fixation. The details of operative procedure are well presented with illustrations.]

Key [587] describes the use of dual plates for the fixation of fractures. One plate has threaded holes to receive the distal end of the screws, and a special guide has been designed for accurate insertion of the screws so that they hit the center of the threaded holes. He used this method only in conjunction with bone graft for nonunion. [ED. NOTE.—This method is well presented as being difficult but of value in selected cases of nonunion. It would seem to have special value in the case of bones which are too soft to afford adequate fixation by standard methods. Where cortical bone is of good quality, a single plate or at the most two standard plates would suffice if the plates and screws are of proper size and design.]

Meekison [588] reported a series of 30 cases, which were followed for over one year, of massive bone graft fixed with vitallium screws. He stated that he had only 1 known failure in a larger series of 170 cases. He made use of a pneumatic tourniquet. In the case of the femur, it was applied above a Steinmann pin inserted above the greater trochanter.

586. Horwitz, T., and Lambert, R. G.: Treatment of Ununited Fractures of Long Bones: A Method Combining Grafting and Internal Fixation, J Bone & Joint Surg. **27**:637-644 (Oct.) 1945.

587. Key, J. A.: Dual Plates for Internal Fixation in Nonunion of Fractures, J. Bone & Joint Surg. **27**:632-636 (Oct.) 1945.

588. Meekison, D. M.: The Treatment of Nonunion or Delayed Union of Fractures by Means of Massive Onlay Grafts Fixed with Vitallium Screws, J. Bone & Joint Surg. **27**:383-386 (July) 1945.

Tibial graft was used. The method of preparation of the graft and host and the fixation of the graft are described. [ED. NOTE.—The technic follows well accepted lines. Emphasis is placed on the use of vitallium, but steel products of 18-8 S-Mo are equally inert and effective.]

Mowlem [589] reports on the use of multiple small chips of cancellous bone in the restoration of defects and loss of contour in 80 cases. This series includes 35 cases of mandibular loss averaging 2 inches (5.08 cm.) in length. He states that while the mandible is not weight bearing it must withstand a biting pressure of from 100 to 200 pounds per square inch (7 to 14 Kg. per square centimeter). He has used external pins for stability while union was occurring but states that a rigid graft or plate may be desired. He feels that grafts of this type are more resistant to infection than cortical bone. He does not recommend grafting in presence of infection as a method of choice but found it safe and successful in some of his cases, with the benefit of penicillin. Only a small number of these cases involved the long bones.

Hand and Wrist.—In treating malunited Colles' fractures Speed and Knight [590] advise that if malunion is present after two weeks manipulation alone may not suffice to correct it. After a study of 60 malunited fractures they state that the objectives are (1) restoration of anatomy, (2) improved function and (3) improved appearance. The site of the fracture was exposed through a dorsal longitudinal incision of adequate length. The operative procedures were as follows: 1. Simple osteotomy of the distal part of the radius in 23 cases with excision of the prominent portion of the ulnar head in some instances. Twenty per cent had partial recurrence of deformity. 2. The resected portion of the ulnar head was wedged into the site of osteotomy of the radius. This did not always restore the radial length. 3. Intramedullary bone graft was used in the radial osteotomy. This method is best when the distal fragment is osteoporotic. 4. Onlay graft was used in 3 cases, in 1 case a dual graft. 5. Arthrodesis. When the fracture is near the joint with severe comminution or osteoporosis, fusion may be the best procedure, often with resection of the distal part of the ulna. 6. Resection of the distal end of the ulna when disability is due to arthritis at the distal radioulnar joint. In young adults and children especially this should be done extraperiosteally, since the ulna may tend to regenerate after subperiosteal resection. [ED. NOTE.—This is an excellent article on this subject. The late correction of malunited Colles' fractures is difficult and often disappointing. Special attention must be paid to the soft tissues and maintenance of the function of the hand.]

---

589. Mowlem, R.: Cancellous Chip Grafts for Restoration of Bone Defects, Proc. Roy. Soc. Med. **38**:171-174 (Feb.) 1945.

590. Speed, J. S., and Knight, R. A.: The Treatment of Malunited Colles's Fractures, J. Bone & Joint Surg. **27**:361-367 (July) 1945.

Waugh [591] reviews the anatomy of the carpal scaphoid and the numerous forms of surgical treatment. In complicated cases either arthrodesis of the wrist or excision of fragments is indicated, and the author favors the latter alternative. He reports 3 cases in which the scaphoid was replaced with a vitallium replica, in 2 successfully and in 1 unsuccessfully. The first prosthesis was solid, weighing 29 Gm. Later ones were hollow, weighing from 12 to 17 Gm., compared to 5 Gm. for the normal bone. The prosthesis is made in three sizes right and left for proper selection. This method is advised in selected cases including certain fresh fractures. [ED. NOTE.—This method seems to be promising.]

Callahan [592] reviews the anatomy of the carpal bones with special reference to the blood supply. A number of cases are presented to illustrate the therapeutic problems involved. He emphasizes the importance of early complete reduction and rigid immobilization until revascularization and union have occurred. Early removal of the ununited proximal fragment of the scaphoid is advised; drilling the bone or grafting of cystic fragments is discouraged.

In the treatment of nonunion of the carpal scaphoid Bentzon and Madsen [593] make a preoperative study of the form and position of the fragments by means of stereoscopic roentgenograms. A rather large curved incision is made, with the base of the flap proximal to and just opposite the styloid process of the radius. The joint capsule is then opened to expose the line of fracture. The fracture is cleaned out in such a manner as to leave a noticeable fissure. Then a flap of subcutaneous fat and connective tissue is interposed and precisely fixed between the fragments. For this purpose, a suture is passed through the point of the flap, and both ends of this suture are passed down through the fracture and out on the volar side of the carpus, where the suture is tied over a small gauze tampon. The radial artery lies in the vicinity, but this artery may easily be palpated, since in this operation a tourniquet is not necessary.

The authors claim that the results from the described method of interposition have been encouraging. [ED. NOTE.—The description of this method does not seem to justify its use in preference to bone grafting. The authors recommend their operation only before arthritic

591. Waugh, R. L., and Reuling, L.: Vitallium Replicas as Replacements After Excision in Ununited Fractures of Carpal Scaphoid: Preliminary Report, Am. J. Surg. **67**:184-200 (Feb.) 1945.

592. Callahan, J. J.; Cubbins, W. R.; Scuderi, C. S., and Hamilton, E.: Revascularization of the Carpal Bones, Radiology **44**:171-176 (Feb.) 1945.

593. Bentzon, P. G. K., and Madsen, A. R.: Surgical Therapy of Pseudarthrosis Following Fractures of Carpal Scaphoid Bone, Nord. med. (Hospitalstid.) **21**:524-527 (March 17) 1944.

changes occur. After these develop fusion of the wrist would seem to be indicated.]

Girdwood [594] makes a strong plea for the prevention of deformities of the hand after fractures, burns and infections. The prevention of deformity, atrophy and fixation depends on immobilization of the hand in the position of function with extension of the wrist, flexion of the metacarpophalangeal joints and freedom of motion in the interphalangeal joints.

Spine.—Rogers [595] reports 4 cases of paraplegia which developed from a few minutes to forty-eight hours after vertebral injury. The patients were all able to walk during the interval and 1 pushed his motorcycle about a mile (1.6 kilometers) before onset of paraplegia. Laminectomy was performed in 2 cases after an interval of about six months. In these 2, which involved the first lumbar and the eighth dorsal vertebra, recovery was incomplete. The other 2 each involved the third and the fourth dorsal vertebrae; paraplegia was incomplete, and they fully recovered within a short period of time. The author classifies vertebral injury as (1) vertebral fracture with immediate symptoms referable to the cord; (2) symptomless fracture without injury to the cord; (3) gross injury to the cord even to complete lesion produced by a blow but without demonstrable fracture (1 case cited), and (4) the fracture with delayed symptoms referable to the cord, as in the 4 cases reported. The 2 cases in which there was late laminectomy had long compression; this was responsible for the paraplegia, which probably resulted from movement of the fragments. The author emphasizes the importance of gentle handling in order to avoid more extensive damage. [ED. NOTE.—The history and observations in the 2 cases in which there was operation would seem to suggest that laminectomy should be done early in this type of case if recovery is not rapid.]

Hallock [596] reports 48 cases of arthrodesis for painful ankle following severe fracture with follow-up after more than one year in 38 cases. Pain and limitation of motion were the usual symptoms. Anterior incision was used with exposure of all articulating surfaces, and the foot was immobilized in 10 degree equinus position postoperatively. In 77 per cent there was solid bony fusion, in 10 per cent there was failure and 13 per cent had doubtful outcome. Twenty per cent of the total had residual pain due to failure of fusion, varus deformity, too much equinus or associated arthritis of tarsal joints. [ED. NOTE.—This is an excellent review and should be studied in its entirety.]

---

594. Girdwood, W.: Immobilization of the Hand and Its Disastrous Effects on Hand Function, South African M. J. **18**:350-352 (Oct. 28) 1944.

595. Rogers, L.: Delayed Paraplegia Following Fractures of the Vertebrae, Brit. J. Surg. **32**:514-517 (April) 1945.

596. Hallock, H.: Arthrodesis of the Ankle Joint for Old Painful Fractures, J. Bone & Joint Surg. **27**:49-58 (Jan.) 1945.

Pseudarthrosis.—Lindemann [597] states that congenital pseudarthrosis is a hypoplastic malformation and is not caused by intrauterine fracture. The signs of hypoplasia are usually first noticeable along the parietal bone, but the structure of the bone in the bent tibia is affected as well. When fracture occurs hypoplasia develops, causing the formation of congenital pseudarthrosis of the leg.

There is no reason to believe that uterine pressure during pregnancy or pathologic modifications of the amnion cause congenital curvatures or fractures of the tibia. Intrauterine tibial fractures frequently occur simultaneously with developmental defects.

In the case of congenital tibial curvatures, fractures may also occur post partum and may lead to pseudarthrosis which is extremely difficult to remedy. On the basis of findings in the literature and of personal cases, the conclusion is reached that the condition is a hereditary hypoplastic malformation in which there is a typical disturbance of tibial structure and growth, with poor formation of callus and bone. [ED. NOTE (L. D. B.).—Moore showed that the so-called congenital pseudarthrosis is another manifestation of neurofibromatosis (von Recklinghausen's Disease) and his belief has been confirmed in many American clinics.] Removal of pseudarthrosis should not be undertaken before the patient reaches the age of 6. The tibia should then be protected by means of bone graft. The hypoplastic fibula of the same side should never be used for bridging. If there is indication of hypoplasia in the other leg the bone graft must be taken from another part of the body.

Malkin [598] reports 2 cases of congenital pseudarthrosis in which treatment by dual grafts from the opposite tibia was successful. In 1 case fixation was obtained with two screws, and in the other case fixation was obtained proximally by wire, while the grafts were implanted in the lower fragment. He feels that the dual grafts prevent the constricting action of scar tissue which may shut off circulation from a single graft.

Von Rosen [599] reports 5 cases of pseudarthrosis of the tibia as a result of osteoclasis for congenital curvature. In 3 cases union was successful after several operative procedures. In 1 case nonunion persisted and in 1 case amputation was necesssary at the age of 8. [ED. NOTE.—This article points out the hazards in attempting to correct this condition.]

1801 K Street, N. W.

597. Lindemann, K.: Pathogenesis of Congenital Pseudarthrosis, Ztschr. f. Orthop. **74**:256, 1943.

598. Malkin, S. A. S.: Congenital Pseudarthrosis of Tibia Treated by Twin Grafts, Proc. Roy. Soc. Med. **38**:71-74 (Dec.) 1944.

599. von Rosen, S.: Some Cases of Congenital Tibial Pseudarthrosis, Acta orthop. Scandinav. **14**:290-301, 1943.

XVI. CONDITIONS INVOLVING THE KNEE JOINT

Prepared by
RALPH K. GHORMLEY, M.D.
Assisted by
JOHN C. IVINS, M.D.; JACKSON E. UPSHAW, M.D.; JOSEPH M. JANES, M.D.;
ROBERT J. GRAHAM, M.D., and FEDERICO L. PADILLA, M.D.
Fellows in Orthopedic Surgery, Mayo Foundation
ROCHESTER, MINN.

Anatomy and Physiology.—Haxton [600] reviews the literature dealing with the function of the patella. Experimental work shows that the patella improves the efficiency of knee extension in the more extended positions by holding the patellar tendon away from the axis and thereby increasing the extending movement of the pull of the quadriceps. Haxton, noting that patellectomy impairs the efficiency of the extensor apparatus, believes that the operation should be avoided if possible but believes it to be indicated in inflammatory and neoplastic diseases of bone and in osteoarthritis when this is confined to the patellofemoral articulation.

Efskind [601] discusses the absorptive function of the synovial membrane. Intra-articular injections of "perabrodil" (iodopyrin injection) were administered in doses of 15 cc., and absorption was controlled roentgenologically. Indigo carmine was administered in doses of 25 cc. of 2 per cent solution, and its concentration in the blood and urine was noted. A total of 49 clinical cases with pathologic changes in the knee joint were examined. The following conditions were studied: 1. Hemarthrosis. In cases in which the hemarthrosis was caused by slight injuries to the synovial membrane there was no regular change in absorption for "perabrodil" or for indigo carmine either immediately after injury or later. There was delay when gross injuries had occurred. 2. Hydrops. In these cases no constant change of the absorptive capacity of the joint was observed with either substance. 3. Arthritis deformans. In the initial stages in which changes of cartilage and bone can barely be detected roentgenologically the absorption time was generally prolonged for both substances. In the severe forms of this condition all degrees of functional reduction of the most serious nature were found. The severest affections of the absorptive capacity were often found in cases in which the synovial membrane was very shrunken and the joint cavity thus was much reduced in size. 4. Pyoarthrosis. As is to be expected these cases showed pronounced functional changes

From the Section on Orthopedic Surgery, Mayo Clinic.

600. Haxton, H.: The Function of the Patella and the Effects of Its Excision, Surg., Gynec. & Obst. **80**:389-395 (April) 1945.

601. Efskind, L.: Clinical Studies on the Function of the Synovial Membrane of the Knee Joint, Acta chir. Scandinav. **88**:37-48, 1943.

which were roughly parallel to the clinical degree of affection. As the clinical symptoms diminished the absorptive capacity gradually approached normal values.

This study tested the absorptive capacity of the synovial membrane and the subsynovial blood vessels only. Larger particulate material would be necessary for functional tests of the lymph vessels.

Congenital Anomalies of the Knee Joint.—Sundt [602] feels that partition of the patella is caused by the absence of fusion in a normal patella with multiple primary centers of ossification; his histologic examinations support the assumption of the possible presence of aseptic necrosis in cases of patella partita. Analyzing the data on the cases reported in the literature Sundt concludes that it is not justified categorically to deny the presence of an infantile patellar osteopathy in these cases. The anomaly itself does not produce symptoms, and if symptoms do exist he feels that they are due to some coincidental lesion in the knee.

Nickerson [603] reviews the development of the knee joint from the embryologic and the phylogenetic aspects. He particularly emphasizes the quadriceps and patellar interrelationship of Carey, who has postulated that formation of joints will occur in those places where centers of growth oppose each other. He presents 2 cases of anomalies of the knee joints with the presence of incomplete vertical septation within the knee. The basic pathologic process has been described as being due to aberrant or pathologic linked genes which possess abnormal mesodermal and ectodermal characteristics, respectively. The primary developmental aberration due to the pathologic gene is manifested by faulty and incomplete differentiation of the premuscular mesenchymal mass which ordinarily is destined to become a portion of the quadriceps extensor apparatus—the vastus internus.

This lack of muscular differentiation has initiated a number of secondary developmental changes in the patella, the quadriceps pouch and the synovial cavity. All these changes have occurred in the medial portion of the knee joint and have exhibited either hypoplastic or aplastic characteristics.

The medial portion of the knee joint possesses older phylogenetic structures than its lateral portion. Anomalies in the medial compartment will present themselves in the form of developmental erasure. Anomalies in the lateral portion will present themselves in the form of accessory growth. It is to be noted that accessory patellar centers are constantly found in the lateral portion.

---

602. Sundt, H.: On Partition of Sesamoid Bones of Lower Extremities: Patella Partita, Especially with Regard to Histological Findings and Relation to Traumatism; Among Others, Six Own Cases Examined Histologically; Contribution to Pathology of Patella, Acta orthop. Scandinav. **13**:1-152, 1942.

603. Nickerson, S. H.: Pathology of the Anomalies Found in Knee Joints, Am. J. Roentgenol. **53**:213-229 (March) 1945.

Pathologic Conditions of the Knee Joint.—Petermann [604] believes that popliteal cysts arise from the synovial membrane of the knee joint, being primary or secondary to a lesion of the synovial membrane. The most common cyst is that which originates in the bursa of the internal head of the gastrocnemius and the semimembranosus muscle. The cysts of articular origin have the tendency to separate from the joint when they are older, while cysts of tendinous origin have a tendency to open into the joint as they grow older. According to Petermann, only the cysts which communicate with the joint give symptoms of functional impairment. In the first stages they produce only pain radiating from the popliteal space to the calf. In spite of their lateral origin, they appear in the middle of the popliteal space.

[ED. NOTE.—The idea that only those cases in which the cyst communicates with the joint produce symptoms is not always accepted, and the editors believe that it may be open to question.]

By an ingenious method Hirsch [605] studied the elasticity of the hyaline cartilage of the patella. The material came from postmortem and operative specimens. It included normal and malacic cartilage. The investigation showed that the healthy articular cartilage had a typical elasticity curve. By staining for chondroitin-sulfuric acid and by chemical analysis it was observed that the content of sulfur bound to esters was lower in malacic than in healthy cartilage. By comparative measurements of elasticity in healthy and malacic cartilage it was shown that whenever the content of chondroitin-sulfuric acid was reduced the cartilage exhibited impaired elasticity, particularly a deterioration in its capacity to withstand loading. The operative specimens showed that malacia with great reduction of the content of chondroitin-sulfuric acid in the cartilage could be present without there being any disintegration of tissue and that when disintegration of tissue did occur it always did so in softened cartilage with a greatly reduced content of chondroitin-sulfuric acid or on the borderline between it and healthy tissue.

Turkell [606] reports a case diagnosed as mixed rheumatoid and degenerative arthritis in which multiple osteocartilaginous bodies were found embedded in the synovial membranes of both knees to such an extent as to simulate osteochondromatosis.

---

604. Petermann, F. E.: Quistes sinoviales del hueco popliteo, Arch. Soc. cirujanos hosp. **14**:427-429 (June) 1944.

605. Hirsch, C.: A Contribution to the Pathogenesis of Chondromalacia of the Patella: A Physical, Histologic and Chemical Study, Acta chir. Scandinav. (supp. 83) **90**:1-106, 1944.

606. Turkell, J. H.: Multiple Osteochondral Bodies in Synovial Membrane of Knee Joints in Cases of Mixed Rheumatoid and Degenerative Arthritis, J. Bone & Joint Surg. **27**:149-154 (Jan.) 1945.

Pique and Schajowicz [607] group under the name "articular lipomatosis" all the diseases, circumscribed or generalized, that originate in the fatty tissues of the synovial membranes with chronic inflammatory and hypertrophic character. They present 3 cases of arborescent lipomatosis, 2 primary and 1 secondary. According to them, the cause in the primary cases was rheumatoid arthritis and in the secondary case was osteoarthritis. The best treatment is synovectomy, sometimes accompanied by patellectomy.

Sjövall [608] analyzes data obtained from 67 biopsies of synovia of the knee for diagnostic purposes at the Lund Orthopedic Clinic from 1921 to 1938, in order to show the value of this procedure in obscure diseases of the knee joint. In 18 cases (27 per cent), the procedure gave a satisfactory answer to the disease of the involved joint. A clue to the correct diagnosis was provided in 2 more cases on histologic examination. A definite diagnosis of tuberculosis was made by this procedure in 13 of the 18 cases. The suspicion, based on microscopic examination, of tuberculosis in another case could not be verified clinically. Tuberculosis did not develop in any joint shown by biopsy to be free of tuberculosis in a subsequent period of observation of twenty-two to five years as shown by a follow-up study in 89 per cent of the cases.

Wiberg [609] distinguishes between cases of osteochondritis dissecans in the knees in which the lesion has healed spontaneously, as judged by freedom from symptoms, and cases in which there is roentgenologic evidence of healing. He considers it reasonable to assume that the healing is more complete in those cases in which the bodies of osteochondritis dissecans fuse with the bone so as to leave no trace of the previous process. He reports 5 additional cases in which conservative treatment led to recovery of this kind; in 1 case the lesion was bilateral, so that a total of 6 knees were included. In 3 cases there was a demarcated nucleus, and in 2 cases the process was diffuse. In analyzing these cases Wiberg notes that the patients were less than 16 years of age when the lesion healed, and he concludes that such a process is not likely to heal after the age of 20 years in any case, perhaps not after 16 or 17 years. If in such cases under conservative treatment pieces of cartilage become detached or if there are persistent annoying symptoms he recommends removal by extraction in order to prevent secondary arthritis deformans. He considers the risk with conservative treatment exceedingly slight.

---

607. Pique, J. A., and Schajowicz, F.: Lipomatosis difusa articular (lipomatosis arborescente), Bol. y trab., Soc. argent. de cirujanos **5**:736-766, 1944; Rev. Asoc. méd. argent. **58**:1113-1123 (Dec. 15) 1944.

608. Sjövall, H.: Ueber den Wert der Probeexzision bei schwer zu diagnostizierenden Kniegelenkaffektionen, Acta chir. Scandinav. **89**:407-416, 1943.

609. Wiberg, G.: Spontaneous Healing of Osteochondritis Dissecans in the Knee-Joint, Acta orthop. Scandinav. **14**:270-277, 1943.

[ED. NOTE.—While there are undoubtedly cases in which osteochondritis dissecans heals spontaneously, it should be emphasized that in such cases the patients must be followed closely, as the damage to the joint may be latent in its clinical manifestations.]

Cox [610] discusses the causation and treatment of traumatic osteochondritis of the patella. The following gross pathologic changes were seen: (1) softening, irregularity in contour and formation of fissures in the articular cartilage of the patella; (2) yellowish discoloration of the articular cartilage in the involved regions; (3) similar changes in the articular cartilage of the femoral condyle on its anteromedial aspect; (4) thickening, hyperemia and villous degeneration of the synovium, usually confined to the region of the suprapatellar pouch and the anterior compartment of the knee; (5) increased joint fluid; (6) formation of pannus at the edges of the articular cartilage of the patella and the femoral condyles. In 6 cases the condition was treated by excision of the patella, and the synovium and degenerated femoral cartilage were left undisturbed. Complete recovery with disappearance of the synovitis and effusion was observed in every case.

[ED. NOTE.—This seems to us an excellent review of this subject, which should be read by every one.]

Wounds and Injuries of the Knee.—Burns, Young and Muller [611] report the results of treatment in 101 cases of wounds of the knee joint. The treatment routine in forward areas consisted of early excision of the wound in all cases except small puncture wounds, suture of the synovial membrane after excision when possible, packing the wounds lightly with sulfanilamide and petrolatum gauze and the administration of penicillin to most of the patients. On arrival at the Emergency Medical Service Hospital penicillin therapy was instituted in all except 9 cases. Exercises for the quadriceps were begun on admission except in cases in which there were signs of acute inflammation. Of 101 patients, 75 eventually recovered with a normal knee, 15 with a useful knee and 11 with a stiff knee. There were no deaths and no amputations.

The authors credit penicillin with the amazing improvement in results when compared with the results of World War I.

Sjövall [612] records the finding of a ganglion formation in a partially ruptured posterior cruciate ligament in a woman aged 21 years. The trouble in the knee began four years before the operation in relation to some injury of which the nature and force were such as to eliminate the

610. Cox, F. J.: Traumatic Osteochondritis of the Patella, Surgery **17**:93-101 (Jan.) 1945.

611. Burns, B. H.; Young, R. H., and Muller, G. M.: Wounds of the Knee-Joint, Lancet **1**:551-553 (May 5) 1945.

612. Sjövall, H.: Ein Fall von Ganglion in einem rupturierten Ligamentum cruciatum genus post, Acta chir. Scandinav. **87**:331-341, 1942.

possibility of rupture of a normal posterior cruciate ligament. Sjövall discusses the classification of such processes and the relationship between the clinical history and operative findings. The idea that the trauma may have played any pathogenic role is discarded; on the other hand, the possibility of minor traumatic injuries as factors of importance is accepted. One must not, however, entirely disregard the possibility of a primary ganglion formation. The case illlustrates the genesis of ganglion formation. Only once earlier has a ganglion with a corresponding localization been described (Coan, 1924).

Internal Derangements of the Knee.—West [613] calls attention to the misuse of the term "internal derangement of the knee" as a diagnosis and notes that the commonest causes for so-called internal derangement of the knee are injuries to the semilunar cartilages and varying degrees of strain or tears of the intrinsic or extrinsic ligaments. Under the general heading "internal derangements of the knee" he lists:

1. Disturbances of the semilunar cartilages
   a. Tears
   b. Cysts
2. Disturbances of the collateral and cruciate ligaments
3. Disturbances of the articular cartilage
   a. Osteochondritis dissecans
   b. Chondromalacia of the patella
4. Dislocations of the patella
5. Disturbances of the fat pads
6. Other derangements
   a. Fractures
   b. Osteochondromatosis
   c. Synovitis
   d. Pellegrini-Stieda disease

West points out that accurate diagnosis and immediate institution of proper treatment are necessary to obtain the best results and feels that, especially in cases of ligamentous injury, proper early treatment, either surgical or conservative, will usually give good results, while late attempts to repair ligamentous injury are discouraging, if not hopeless.

The anatomy of the knee is discussed, and it is pointed out that "the first maxim in the treatment of knee conditions is to strengthen the quadriceps—for without adequate quadriceps power a normal knee will not be obtained."

One hundred consecutive cases of derangement of the knee joint admitted to West's service in an army general hospital are tabulated according to diagnosis, and there are excellent brief discussions of the diagnosis and treatment of the various types of internal derangement.

---

613. West, F. E.: Diagnosis and Treatment of Internal Derangements of the Knee, S. Clin. North America **25**:111-135 (Feb.) 1945.

Severin [614] describes a peculiar free body originating in a knee joint. This body, which clinically was observed freely movable in the joint for six or seven weeks, consisted of a blood clot partly surrounded by coarsely trabecular, collagenous connective tissue, poor in cells. The presence of capillary vessels in this "capsule" indicates that the clot was formed subsynovially and later became detached. Since the connective tissue had not become necrotic, it must have been nourished by the synovia.

Jaekle [615] reports his results in 155 cases of torn semilunar cartilages. Operation was not advised or done if it appeared that the patient had not the will to get well. In all cases the patient was taught exercises for the quadriceps before operation. In the repair of bucket handle tears only the torn portion was removed and the border of the remaining portion was cleanly excised. For other types of tear most of the meniscus was removed but a small rim was left. Surgical intervention was advised within a short time after injury, particularly in bucket handle cartilages not reduced by manipulation. One hundred and thirty-two patients, 85 per cent, were returned to regular duty on an average of twenty-five days after operation for injuries incurred from a few days to eleven years before.

Sjövall [616] reports a clinical analysis of data on 144 cases of total meniscal extirpation performed in the orthopedic clinic at Lund, Sweden, in the period of 1929 to 1938. When the patients were followed up by questionnaires, it was found that 2 patients had died. In all but 1 case a reply was made to the questionnaires. Out of 120 men and 23 women with 116 medial and 33 lateral meniscuses removed, 60 per cent were manual laborers. Thirty-three per cent of primary lesions were due to athletic injuries. Coincidental pathologic changes were: injuries to cruciate ligaments (in 11 per cent of the patients); osteochondritis dissecans (in 6 per cent); chondromalacia of the patella (in 27 per cent), and arthrtitis deformans (in 10 per cent). The average period of hospitalization was one month. The average stay at home was one month. Manual laborers resumed work on the average later than nonmanual workers and insured persons resumed work later than uninsured persons.

The function of the knee was estimated with a view to the appearance of the knee, its mobility and gross strength, and the presence of

614. Severin, E.: Eigentümlicher freier Körper im Kniegelenk, Acta chir. Scandinav. **88**:33-36, 1943.

615. Jaekle, R. F.: Internal Derangements of the Knee Joint, Arch. Surg. **50**:271-276 (May) 1945.

616. Sjövall, H.: Die Spätergebnisse nach totaler Meniscusexstirpation; klinische Analyse und Nachuntersuchung von 144 in den Jahren 1929-1938 an der Lunder Orthopädischen Klinik operierten Fällen, Acta orthop. Scandinav. **13**:153-217, 1942.

crepitation and pain. Also considered was the influence of the length of the period of observation, duration of illness and age of patients at time of injury, operation and reexamination.

Group	Results	Cases	Percentage of Group
I	Perfectly free from all inconvenience	28	20
II	Good results; practically free from inconvenience, with merely an insignificant subjective complaint	72	52
III	Fair results, more pronounced inconvenience, slight functional disturbances	37	26
IV	Poor results and marked, in part disabling, trouble; in none of these 3 cases are results due to meniscectomy as such	3	2

These results do not support warnings of several clinicians against operative treatment of meniscal lesions. Sjövall indicates that subjective symptoms in these cases do not show a more frequent tendency to arthritis deformans than in other series and goes against the assumption that surgical treatment enhances the risk of early postoperative arthritis deformans. He discusses indications for surgical treatment and advises immediate operation when there is recent unquestionable meniscal injury or lesion. In obscure cases he advises conservative treatment; the first sign of a relapse will then constitute an absolute indication for arthrotomy.

Stanek [617] reports the results of 150 consecutive arthrotomies of the knee done in military service. No infection was noted in the entire series. Operations were done with the patient under spinal anesthesia. A narrow Esmarch tourniquet was used. In 2 cases transient paralysis was noted. In simple cases of meniscal injuries, following excision and closure, sheet wadding and muslin dressings were applied. Exercises for the quadriceps were initiated on the first postoperative day. The patient was allowed up and about without crutches, often on the second or third postoperative day, as soon as he could raise the leg from the bed unassisted.

In 105 cases there was injury only to the meniscuses, ligaments or fat pads. Eighty-six medial and 15 lateral torn meniscuses were removed. In 2 cases only was there injury to both meniscuses of the same knee. Fifty-four bucket handle, 20 anterior, 10 posterior and 3 minimal tears (loose anterior attachments) were noted. Ninety-seven of the 105 patients who had such injuries returned to some type of duty. In 24 cases there were disorders of bone or articular cartilage including 9 cases of osteochondritis dissecans and 11 cases of chondromalacia of the patella. In 5 cases there was severe arthritis. In 9 cases there were old or recent fractures of the patella, tibial spine or tibial plateau. In 4 cases purely exploratory arthrotomy was done with uniformly poor results. Three unusual conditions involving the knee were noted and described in detail, including a hemangioma of the fat pad with invasion

617. Stanek, W. F.: Internal Derangements and Fractures Involving Knee: Results of One Hundred and Fifty Consecutive Arthrotomies Performed at Station Hospital, J. Bone & Joint Surg. **27**:86-94 (Jan.) 1945.

of the patellar ligament. Stanek is of the opinion that simple cases of meniscal injuries show a high percentage of excellent operative results which are not affected to any extent by injuries of the cruciate ligaments. Concomitant injuries of collateral ligaments or chondromalacia of the patella gives a poor prognosis. Loose bodies with old osteochondritis dissecans have a good prognosis following surgical treatment. The prognosis as to return to military duty following operation is poor in cases showing arthritis or fractures of the tibial plateau.

Bingham and McDonald [618] report a case in which a young soldier serving in India presented the typical history and physical findings of a cyst of the external semilunar cartilage of the knee, but at operation the lesion was found to be a cyst lying between the capsule and the synovial membrane, which on microscopic examination proved to be a filarial nodule. Attention is called to the fact that the statements made by other authors that a cartilage cyst is the only tense swelling which is located exactly in the middle of the lateral surface of the knee at the level of the joint line or that cartilage cysts are the only form of cyst occurring on the lateral joint line are not quite true.

Dislocations of the Knee.—Lasher [619] notes that complete dislocations of the knee unaccompanied by fractures are sufficiently rare to deserve reporting. The marked lateral angulation and rotation accompanying such dislocations are frequently accompanied by circulatory changes, emphasizing the urgent necessity of the earliest possible reduction. A cadet, aged 23 years, dislocated his left knee while playing football. The exact mechanism of the injury was not determined. When the patient arrived at the hospital fifteen minutes after the injury the entire leg and foot were completely blanched. An immediate reduction, with the patient under general anesthesia, was made on the x-ray table. Firm traction was exerted on the leg while at the same time the patella was forced upward and direct pressure was made to overcome the lateral displacement. The reduction was accompanied by a local thud, and almost immediately the circulation in the toes returned to normal. A circular cast was applied with the joint in extension. The cast was cut throughout its entire length and the following day there was considerable swelling. The joint was acutely painful for seven days. On the fourteenth day the foot was partially freed from the plaster and the patient was permitted to use crutches. On the twenty-fifth day the cast was removed and a walking caliper was applied, which he continued to wear for two months after the injury. Physical therapy and exercises were begun on the twenty-seventh day and continued for three months from the date of

618. Bingham, J. A. W., and McDonald, S.: A Filarial Nodule Simulating a Cyst of the External Semilunar Cartilage, Brit. J. Surg. **32**:326-327 (Oct.) 1944.

619. Lasher, W. W.: Complete Dislocation of the Knee Unaccompanied by Fracture, Indust. Med. **14**:188-189 (March) 1945.

injury. When the caliper was removed an elastic bandage was used for a month. Carefully supervised exercises developed the thigh to its original size. Several months after the injury there was no evidence of the original injury, and the patient was carrying out his duties as an aviation officer.

Roentgenologic Examination.—Andersen,[620] after pointing out that the methods for arthrography of the knee hitherto employed have not given fully satisfactory results, especially as regards the visualization of the semilunar cartilages, proceeds to give a description of a method first advanced by Mohemann and Madleuer in 1942. Briefly, the method consists of injection of a gaseous mixture, such as nitrous oxide, which Andersen used, into the knee joint and then roentgenoscopic and roentgenographic examination of the knee while traction with adduction or abduction is applied to the leg to allow diffusion of the gas completely around the semilunar cartilages. About 60 to 100 cc. of the gas is injected under sterile precautions, the patient is placed in a prone position on the table, and the thigh is immobilized with a strap. Roentgenoscopic examination of the knee is then performed with an assistant to move the leg as the observer directs. The semilunar cartilages are said to be visualized clearly and, with proper adjustment of the projection, roentgenograms are taken of the knee in straight and posteroanterior views, with slight inward rotation, maximal internal rotation and slight and maximal lateral rotation, in orienting front and side pictures and, lastly, in Frik's projection.

Grossman and Minor [621] found that by combining the injection of a small amount of air with forced abduction and adduction of the knee during roentgenography they were able to visualize both semilunar cartilages satisfactorily. The site chosen for the injection is just lateral to the patellar ligament at the knee joint through the ligamentum mucosum. A 20 gage needle with a 30 cc. syringe is used. After the fluid has been aspirated, 10 to 20 cc. of atmospheric air filtered through several thicknesses of gauze is slowly injected into the joint. After the air has been injected the needle is withdrawn and the puncture wound is sealed with collodion. A device for immobilizing the knee and one for applying the lateral traction on the thigh are desirable. Anteroposterior roentgenograms are made in abduction to visualize the medial semilunar cartilage and in adduction to visualize the lateral one. Roentgenograms are made in the prone and supine positions in order to visualize the posterior and anterior horns. The Trendelenburg position is used to keep any fluid remaining in the joint in the anterior suprapatellar

620. Andersen, K.: Some Experiences with a New Method for Arthrography, Acta radiol. **25**:33-39, 1944.

621. Grossman, J. W., and Minor, H. H.: Roentgen Demonstration of the Semilunar Cartilages of the Knee, Am. J. Roentgenol. **53**:454-465 (May) 1945.

extension of the articular cavity. The thigh is elevated to prevent contact of the patella with the table so that true positioning may be obtained.

Because each case varies, there are no constant pathologic pictures with the exception of bucket handle tears with dislocation. The pathologic changes seen may be gross or minimal and consist of fractures or tears with or without degenerative changes (thinning and fraying). The cruciate ligaments are often visualized. In several cases effects of the articular cartilage have been noted. It is well to do pneumographic studies on several normal knees to become acquainted with the normal appearances. It is claimed that the use of small amounts of air precludes the possibility of air embolism. The authors have found that the lateral meniscus is fractured more often than is believed, and in many cases both cartilages have been shown to be pathologic.

Surgical Procedure.—Abbott and Carpenter [622] present a discussion of the anatomic details of surgical approaches to the knee joint based on their clinical experience and that of their colleagues, on a comprehensive review of the available literature on the subject and on a survey of a number of dissections performed on cadavers and freshly amputated specimens. Surgical approaches are planned either to avoid the exposure of vital structures or to expose them deliberately. The first method may be used if adequate exposure of the lesion or lesions can be secured and if there is only a remote possibility of injury to vital structures. The writers, however, stress the use of the second method in all instances in which the incision is planned to give the most direct access to the lesion, regardless of the proximity of vital structures. In order to expose vital structures in the path of the dissection or in its immediate vicinity an exact knowledge of the anatomic relations involved is paramount, and on this premise the authors proceed to develop their discussion. General anatomic considerations of the knee are given first with a description of the capsule, the synovia, the bursas, the blood supply and the cutaneous nerves surrounding the joint.

The various approaches to the knee joint are then considered with a concise but complete description of the surgical anatomy on the anterior, medial, posterior and lateral aspects of the knee joint, the indications for the various approaches as each is described, the position of the patient in each, the anatomic landmarks for each incision and a detailed anatomic description of each approach.

Approaches to the anterior aspect of the knee joint are described under the following headings: the parapatellar incisions, including the median parapatellar incision (von Langenbeck), the S-shaped parapatellar incision (Payr), the oblique parapatellar incision (Erkes) and

622. Abbott, L. C., and Carpenter, W. F.: Surgical Approaches to Knee Joint, J. Bone & Joint Surg. **27**:277-310 (April) 1945.

the lateral parapatellar incision (Kocher); incisions which divide the patella, including the vertical division of the patella (Brackett and Hall, Jones), the transverse division of the patella (von Volkmann), sagittal division of the patella (Devine) and the oblique division of the patella (Bougot and De La Rue); incisions which divide the tendon of the quadriceps muscle, with résumés of the method of plastic division of the quadriceps tendon as described by Putti and by Campbell and plastic division of the quadriceps tendon as described by Coonse and Adams; the incisions which divide the patella transversely including the U-shaped incision (Textor) and the H-shaped incision (Ollier).

An S-shaped incision to the medial aspect of the joint which extends from 2 inches (5 cm.) above the adductor tubercle to the joint level, then forward to the anterior border or the upper end of the tibia and then downward to end just below the tibial tubercle is described minutely. In cases in which a more limited exposure is sufficient a straight or simple curved incision extending downward from the adductor tubercle is mentioned.

As was done in respect to the approaches from the medial aspect, an S-shaped incision for approaching the lateral aspect of the knee joint is given with indications for the approach, position of the patient, anatomic landmarks and surgical anatomy and with a complete anatomic description of the incision. As in the case of the medial aspect of the knee, a straight or curved incision is mentioned for use in cases in which only limited exposure is needed.

The following approaches are described for the removal of the semilunar cartilages: approach for partial removal of the internal semilunar cartilage, approach for complete removal of the internal semilunar cartilage, approach for partial removal of the lateral semilunar cartilage and approach for complete removal of the external semilunar cartilage. In regard to approaches for removal of the internal semilunar cartilage the Cave, Bosworth and Fisher incisions are described.

The following bilateral incisions are described: incisions for exposure of the popliteal face of the femur (Henry), approaches for epiphyseodesis (Abbott and Gill), incisions for removal of loose bodies from the posterior compartment of the knee (Henderson) and approaches for posterior capsulotomy in flexion contractures of the knee (Wilson). A midline approach to the posterior aspect of the knee joint through the popliteal space is detailed. The last section is a discussion of the various approaches for drainage of sepsis of the knee joint.

Buirge[623] describes the removal of the medial semilunar cartilage of the knee through a single anterior capsular incision facilitated by the use of a "broad sharp dissector" and a "narrow dissector." These

623. Buirge, R. E.: A Sharp Dissector for Meniscectomy, Surgery **16**:956-958 (Dec.) 1944.

instruments are used to cut the cartilage free from its capsular and fibrous attachments after the capsule has been incised. The instruments are constructed from sharp periosteal elevators in such a way as to be safe for their intended purpose and should be of value to the orthopedic surgeon.

Labry [624] discusses treatment of recent hemarthrosis. In such cases he uses aspiration with immobilization for ten days. In case of ligamentous tear a procaine hydrochloride block is carried out. The same procedure is carried out in cases in which the patient is seen one month or less after injury, while in cases in which the patient is seen several months after injury Labry advises long immoblization, frequent infiltration, lumbar infiltration, perifemoral sympathectomy and physical therapy.

Morrison [625] describes an eyelet knife designed and fashioned from a hacksaw blade. With this knife, blind dissection of the posterior part of the cartilage became the easiest part of the operation. The anterior and medial aspects of the cartilage were detached under direct vision in the usual manner. The cartilage was passed through the eyelet of the knife and while tension was kept on the cartilage, the posterior part was easily removed.

Only structures within the eyelet can be cut as the knife automatically retracts other structures and blind dissection is not hazardous.

Haggart and Thomas [626] record experience with arthrodesis of the knee joint in 3 cases, using the Stader splint. The diagnoses were: tuberculosis, completely unstable knee and destructive arthritis, respectively. They prefer the curved type of resection of the femur and tibia, with removal of a minimal amount of bone, thus preserving the maximal leg length. The operative technic is a modification of the original Hibbs operation, and comprises minimal bone resection of the condylar surfaces, followed by countersinking the patella in the femur and tibia as a bridging bone graft. Ten days later, with the patient under intravenous pentothal sodium anesthesia, the sutures are removed from the operative incision and the Stader splint then is applied, the proximal pins in the femur, the distal pins in the tibia. The unit is then "taken up" so that by roentgenologic examination adequate contact of the raw bone surfaces is evident. A roentgenogram of this position is again secured in two or three weeks, when the unit is further tightened so that firm impaction is maintained.

---

624. Labry, R.: A propos du traitement difficile des hydrohémarthroses traumatiques du genou, Lyon chir. **37**:73-78, 1941-1942.

625. Morrison, G. M.: A New Knee-Cartilage Knife, U. S. Nav. M. Bull. **44**:404-405 (Feb.) 1945.

626. Haggart, G. E., and Thomas, G. L.: Use of the Stader Splint in Arthrodesis of the Knee Joint (Preliminary Report), Lahey Clin. Bull. **4**:85-89 (Jan.) 1945.

The Stader splint is removed in six to eight weeks and a snug-fitting, long leg plaster cast is applied, adjusted for weight bearing. The patient thereupon becomes ambulatory with crutches and progressively bears weight on the extremity. The patient is kept in bed during the time the pins are in place in order to minimize the chance of infection of the pin tract. None of the patients so treated has exhibited pin seepage.

In the 3 cases described, firm bone ankylosis of the knee joint was demonstrated both clinically and roentgenologically in twenty weeks, twelve weeks and twelve weeks, respectively.

Thompson [627] points out that residual disability following severe injury to an extremity is just as often due to loss of function of the soft parts as to malunion, nonunion or infection of the bones. The latter conditions can be prevented or corrected, but with injuries of the soft parts complete restoration of normal function is rarely attained, since when tissues with very specialized functions are replaced or surrounded by scar tissue considerable loss of function is inevitable. Excision and isolation of scar tissue in the extensor mechanism of the thigh is described as an operative procedure to increase motion in the knee, particularly flexion, following injuries to the thigh. Ninteen cases are reported, in all of which satisfactory results were obtained as far as increase of flexion is concerned. Thompson's method involves excision of the scarred vastus intermedius; the knee is flexed to 90 degrees or beyond, without lengthening the rectus femoris muscle, by making a new intermuscular septum of soft tissues. The intact rectus femoris permits early active motion, and this factor is the reason why most of these patients have regained full active extension.

[ED. NOTE.—Thompson's operation is an advance in the treatment of postfracture fixation of the knee. In our experience the adhesion of the capsule of the knee joint to the margins of the joint has been a prominent finding in these cases and flexion cannot be obtained until the adhesion is freed.]

Guildal [628] reports 4 cases of complete or almost complete ankylosis of the knee at an angle between 120 and 80 degrees. The cause of the ankylosis was an inflammatory process in the knee. The knee was straightened out by osteotomy, wedge-formed in 2 cases, arcuate in 2, followed by wire traction (through the tuberosity of the tibia or the calcaneum). The results were practically complete straightening of the angle and firm osseous ankylosis. Two cases were complicated, one by exacerbation of the earlier osteomyelitic process, the other by the fact that the traction wire cut through the bone and gave rise to osteitis.

627. Thompson, T. C.: Quadricepsplasty, Ann. Surg. **121**:751-754 (May) 1945.

628. Guildal, P.: Ankylosis of the Knee with Marked Angulation: Straightening by Osteotomy and Wire-Traction, Acta chir. Scandinav. **87**:138-144, 1942.

In all cases a reduction was obtained in the practical shortening and the patients were able to get along with a heightened boot.

Recurrent Dislocation of Patella.—Sjövall [629] reports on 27 patients (30 knees) on whom operation was performed for recurrent dislocation of the patella; 2 patients (3 knees) for habitual dislocation, and 4 patients (5 knees) for persistent dislocation (Blumensaat classification). Cases were analyzed from pathologic, etiologic and clinical points of view. He describes surgical technic and observations on reexamination. The Krogius operation was suitable as basal procedure; only in a few cases was it supplemented. There was a relapse in 3 (12 per cent) of the cases of recurrent dislocation, and this was due to intense strain or forceful injury. No relapse was noted in cases of habitual dislocation. In 1 case of persistent dislocation a relapse occurred; recurrent dislocation developed in one knee, but the other knee had excellent function. There were excellent results in 97 per cent with the Krogius procedure and less satisfactory results in 3 per cent of the cases. The results were attributed to consistency of treatment, low average age of patient and the selection of cases. Early operative treatment is emphasized.

XVII. CONDITIONS INVOLVING THE KNEE JOINT

Prepared by
MARK B. COVENTRY, M.D.
Assisted by
CAMERON ALLEN, M.D.; ROBERT B. ELLIOTT, M.D.; ALFRED E. JACKSON, M.D.; EINER W. JOHNSON, M.D.; JACK PASCHALL Jr., M.D., and ARNULF R. PILS, M.D.
Fellows in Orthopedic Surgery, Mayo Foundation
ROCHESTER, MINN.

Roentgen Diagnosis.—Gershon-Cohen [630] describes roentgenographic technic for observation of the soft tissue of the knee. Anteroposterior, lateral, oblique, longitudinal and intercondylar roentgenographic views of both knees should be made routinely. By strong traction, abduction or adduction of the leg, a transient vacuum can be created in the articular space and the outline of the meniscuses will be revealed in the roentgenogram. More than 8 to 10 cc. of synovial fluid, however, interferes with such a vacuum and prevents visualization of the meniscuses. The

---

From the Section on Orthopedic Surgery, Mayo Clinic.

629. Sjövall, H.: Zur Frage der rezidivierenden und permanenten Kniescheibenverrenkungen, unter besonderer Berücksichtigung der Behandlung und Behandlungserfolge, Acta orthop. Scandinav. **14**:185-218, 1943.

630. Gershon-Cohen, J.: Internal Derangements of the Knee Joint: The X-Ray Diagnosis, Rhode Island M. J. **28**:570 (Aug.) 1945; Internal Derangements of the Knee Joint: The Diagnostic Scope of Soft Tissue Roentgen Examinations and Vacuum Technic Demonstration of Menisci, Am. J. Roentgenol. **54**: 338-347 (Oct.) 1945; Derangements of the Knee Joint: Diagnostic Aid Obtained by the Roentgenologic Examination of the Soft Structures and of the Menisci Without Injection of Contrast Media, U. S. Nav. M. Bull. **45**:488-499 (Sept.) 1945.

author feels that loose bodies, sprain of the tibial collateral ligaments, periarticular bursitis, cysts of the meniscuses, neoplasms and miscellaneous lesions of soft tissue can be diagnosed if this technic is used.

McGaw and Weckesser [631] discuss the use of pneumarthrography in 508 examinations of the knee among army personnel. They describe the technic when oxygen is used and outline a method of interpreting the findings. Of interest are the popliteal bursas which were found to communicate with posterior pouches in 14.4 per cent of the 508 knees examined in this way.

Herzog [632] states that the main indication for pneumarthrography is in distinguishing simple traumatic synovitis which calls for conservative management from torn meniscuses which need operative management.

Wounds of the Knee.—Newman [633] discusses the early treatment of wounds of the knee. He divides the wounds into three groups, "slight," "moderate" and "severe." He presents data on 10 slight wounds, 39 moderate wounds and 8 severe wounds in a total of 57 cases. For the group of slight wounds treatment consisted of aspiration, intra-articular administration of penicillin and immobilization of the extremity in a cast. For the group of moderate wounds treatment consisted of careful excision, primary suture, intra-articular and parenteral administration of penicillin and immobilization of the joint in extension with a Thomas splint. The group of severe wounds presented a more difficult problem. Five wounds were left open. The author stresses the need of roentgenographic examination as an aid to diagnosis, and the early removal of foreign bodies.

Mitchell [634] analyzes 800 consecutive cases of injury of the knee among army personnel. He found that 13.5 per cent of the 800 patients had penetrating wounds of the knee, four fifths of which were war wounds. Thirty per cent had a lesion of the meniscus, 25 per cent synovitis of various types, 7 per cent a ligamentous injury and 6 per cent osteoarthritis.

Internal Derangement of the Knee.—[ED. NOTE.—Many articles continue to be written on the management of internal derangements of the knee, especially tears of the meniscuses among military personnel. Most of them seem to be in agreement as to selection of cases and operative results in general.] Willien [635] presents the results of a two year

631. McGaw, W. T., and Weckesser, E. C.: Pneumarthrograms of Knee: Diagnostic Aid in Internal Derangements, J. Bone & Joint Surg. **27**:432-445 (July) 1945.

632. Herzog, E. G.: Air Arthrography in Diagnosis of Torn Semilunar Cartilage, Lancet **2**:5-6 (July 7) 1945.

633. Newman, P. H.: Early Treatment of Wounds of Knee Joint, Lancet **2**:632-633 (Nov. 17) 1945.

634. Mitchell, G. A. G.: Analysis of Eight Hundred Consecutive Knee Cases, J. Roy. Army M. Corps **83**:271-273 (Dec.) 1944.

635. Willien, L. J.: Second-Year End Results of Arthrotomies of Knee, Bull. U. S. Army M. Dept. **4**:452-456 (Oct.) 1945.

follow-up in 75 cases in which arthrotomy of the knee was performed in an army hospital within the continental limits of the United States. In the majority of the cases a torn meniscus or osteochondritis dissecans was present. Sixty-two and six-tenths per cent of the men were retained in the army, 38.6 per cent on full duty and 24 per cent on limited service. Willien concludes that if derangement of the knee antedates enlistment, the patient should be reclassified or discharged. If it is connected with service, he should be operated on if this is the treatment indicated, after careful evaluation of his emotional status.

Dwyer and Taylor [636] report a case of discoid internal meniscus of the knee. They assume that this is the only case of internal discoid meniscus reported in the literature. The patient was a soldier, 29 years old, who had signs and symptoms compatible with a bucket handle tear. At operation a complete fibrocartilaginous "dish" was found with a longitudinal tear.

Mitchell [637] studied 241 cases in which lesions of the meniscuses were present. The cases were obtained from 800 cases in which consecutive operations were performed on the knee. In 73 per cent the internal cartilage was torn and in 17 per cent the external. In 9 per cent a cystic cartilage was found, and in 1 per cent a discoid cartilage. Pathologic studies revealed degenerative changes in the cartilage and synovial membrane in cases in which the injury had occurred sometime previously and relatively little change in cases in which it was recent. The cystic cartilages were polycystic.

Another statistical study of army personnel was done by Garden,[638] who studied 628 cases of internal derangement. In 325 of these a diagnosis of torn semilunar cartilage was made, and in 206 operation was performed. An anterior incision was used. If the anterior half of the cartilage remained attached to the posterior half, no posterior incision was used. If the anterior half had separated from the posterior half, a posterior incision was made in addition. All the cystic cartilages were removed to prevent recurrences.

Mintz [639] studied more than 100 injuries to the knees treated conservatively and 64 treated surgically. In 62 of these injured meniscuses were present and in 2, cysts. Mintz warns against operating on military patients who have osteoarthritic changes, but advocates this procedure in civil practice when indicated. [ED. NOTE.—This is the

636. Dwyer, F. D., and Taylor, C.: Congenital Discoid Internal Cartilage, Brit. M. J. **2**:287 (Sept. 1) 1945.

637. Mitchell, G. A. G.: Lesions of Fibrocartilages: Study of Types, Positions and Pathological Changes, J. Roy. Army M. Corps **83**:198-200 (Oct.) 1944.

638. Garden, R. S.: Meniscectomy in Soldier, J. Roy. Army M. Corps **84**: 119-124 (March) 1945.

639. Mintz, B. J.: Internal Derangements: Diagnosis and Treatment, Am. J. Surg. **70**:189-196 (Nov.) 1945.

consensus of those experienced in military surgery.] He also advocates complete excision of the cartilage through two incisions.

Studies on civilians have also been made. Du Toit and Enslin [640] analyzed 100 cases in which arthrotomy was performed for injured meniscuses. They carefully evaluated all preoperative signs and symptoms. They found at operation tears of the medial cartilages in 82 cases, of the lateral cartilages in 9, no tear in 4, bilateral tears in 3 and a discoid meniscus in 2. In correlating their observations with the physical signs they found that (1) pain in the anteromedial line of the joint is of diagnostic importance, (2) absence of this pain contraindicates arthrotomy, (3) locking frequently but not always occurs, (4) damage to a meniscus may exist in the absence of wasting, (5) osteochondritis dissecans and traumatic lesions of the cartilage of the medial patellar facet (Fouché's hot spot) may cloud the diagnostic picture and (6) most of these findings favor early and total meniscectomy.

Cave, Rowe, and Yee [641] report the results of a two year follow-up in 121 cases in which arthrotomy was carried out in an overseas army hospital. Of the patients admitted to the hospital with complaints referable to the knee, 29 per cent required operation. The significant observations were as follows: 1. Of those who demonstrated a torn meniscus at operation, 98 per cent gave a history of a twist injury of the knee, 70 per cent of locking, 95 per cent of swelling of the joint and 97 per cent of pain or injury. 2. Physical observations of importance consisted of (*a*) atrophy of the quadriceps muscle in 68 per cent of the cases of torn meniscuses, (*b*) tenderness in the line of the joint and prominence of the meniscus in 88 per cent, (*c*) excess articular fluid in 50 per cent and (*d*) limitation of motion, especially extension, in 63 per cent. 3. Operative findings in the 88 cases of torn meniscuses were tears in the medial cartilage in 87 per cent and in the lateral cartilage in 12 per cent. Osteochondritis dissecans was found in 15 of the 121 cases. Patellar chondromalacia was found in 11 cases. 4. Postoperative complications consisted of sepsis in 1 case, thrombophlebitis in 1 and temporary sciatic nerve palsy in 4 cases.

Schwartz [624] in another study made in an overseas hospital found that of 110 patients admitted in fifteen months, 16 per cent were admitted for injuries to the knee. Of this 16 per cent, 31 per cent were operated on.

640. du Toit, G. T., and Enslin, T. B.: Analysis of One Hundred Consecutive Arthrotomies for Traumatic Internal Derangement of Knee Joint, J. Bone & Joint Surg. **27**:412-425 (July) 1945.

641. Cave, E. F.; Rowe, C. R., and Yee, L. B. K.: Selection of Cases for Arthrotomy of Knee in Overseas General Hospital: Two Year Follow-Up Study, J. Bone & Joint Surg. **27**:603-607 (Oct.) 1945.

642. Schwartz, M.: Injured Knee, Bull. Hosp. Joint Dis. **5**:55-59 (Oct.) 1944.

An analysis of the surgical cases is presented. The author is an advocate of the 5 inch (12.7 cm.) parapatellar incision in all cases.

Harmon [643] reports 2 interesting cases of osteochondral fractures in adolescents, and he is of the opinion that the condition should be better known. In one case the lateral femoral condyle was involved; in the other the patella, after dislocation. Because of the amount of cartilage present in adolescents, roentgenologic visualization of osteochondral fractures is difficult. Treatment is early arthrotomy and excision of the loose fragment.

Wilkinson and Burt [644] blame the poor results in arthrotomy on (1) unnecessarily long periods in the hospital and (2) delay in treating the complications. They mention localized periarticular tenderness, synovial effusion, instability of the joint and inability to "brace back" the knee.

Heebner [645] discusses the "first aid" treatment of sprains of the knee and tears of cartilage. He emphasizes the application of cold instead of heat to the knee for the first two or three weeks.

Pellegrini-Stieda Disease.—Allen [646] based his study on 1,564 cases in which roentgenologic examination of the knees was made at a large station hospital. In 28 cases Pellegrini-Stieda disease (calcification of the medial collateral ligament of the knee due to trauma) was found. The lesion was bilateral in 7 cases. Twenty-six patients had pain, limited motion, swelling after use or localized tenderness. There was a history of trauma in 21 cases. Allen considers trauma the inciting cause of hemorrhage around the medial epicondyle into the attachments of the tibial collateral ligament, vastus medialis or adductor magnus. Organization of this hemorrhage results in deposition of calcium at this site.

Nachlas and Olpp,[647] on the other hand, stated that the disease is due not to a fragment of bone from the femur, a tear of the periosteum, or a calcified bursa but to a process of attrition on the inner aspect of the sliding membrane over the adductor tubercle. This attrition is speeded by the tissue swelling of polyarticular or traumatic arthritis. They also stress the coexistence of chronic arthritis of the knee. They emphasize that Pellegrini-Stieda disease is not a disease complex.

---

643. Harmon, P. H.: Intra-Articular Osteochondral Fractures as Cause for Internal Derangement of Knee in Adolescents, J. Bone & Joint Surg. **27**:703-705 (Oct.) 1945.

644. Wilkinson, L. H., and Burt, H. A.: Knee Injuries in Soldiers, Lancet **1**:684-686 (June 2) 1945.

645. Heebner, R. A.: Sprains in Knee Joint Injuries, Hosp. Corps Quart. **18**:40 (Nov.) 1945.

646. Allen, W. E., Jr.: Post-Traumatic Para Articular Calcification of Knee Joint, J. Nat. M. A. **37**:164-167 (Sept.) 1945.

647. Nachlas, I. W., and Olpp, J. L.: Para-Articular Calcification (Pellegrini-Stieda) in Affections of Knee, Surg., Gynec. & Obst. **81**:206-212 (Aug.) 1945.

[ED. NOTE.—This is certainly true. A new name, based on a description of this condition, is needed; how about "paracondylar calcification of the femur?"]

Patellar Chondromalacia.—Cave, Rowe, and Yee [648] consider that chondromalacia of the patella is a definite pathologic entity. They state that the progress of this condition is as follows: first phase, patellar contusion; second phase, chondromalacia, and third phase, degenerative chondral changes and synovitis.

In 9 (7 per cent) of 124 consecutive cases in which arthrotomy was performed for internal derangement of the knee chondromalacia of the patella was found. The gross and microscopic pathologic changes then are discussed. It is emphasized that the roentgenograms did not reveal abnormalities. Treatment is surgical and is of three types, depending on the severity of the disease: (1) removal of the involved tissues; (2) patelloplasty, with horizontal resection of two thirds of the patella and interposition of the fat pad between the remainder of the patella and the condyles and (3) patellectomy.

Soto-Hall [649] found chondromalacia of the patella in 12 (18.5 per cent) of 65 consecutive cases in which arthrotomy was performed. In 6 of these 12 total patellectomy was done. Soto-Hall classifies surgical procedure into the same three types that Cave, Rowe, and Yee did.

Traumatic Degeneration of the Head of the Gastrocnemius Muscle.—Cohen [650] presents a case of traumatic degeneration of the medial head of the gastrocnemius muscle simulating a semimembranous bursa. A man 39 years old fell and struck the popliteal region. When he was examined three weeks later, a globular cystic swelling was present posteriorly in the popliteal space. A diagnosis of semimembranous bursa was made. At operation a swelling composed of fibrofatty material involving the medial head of the gastrocnemius muscle was found. On microscopic examination striated muscle which had undergone degeneration, atrophy and replacement with fat was noted. Cohen postulates that trauma caused deep rupture of the medial head of the gastrocnemius with secondary degeneration and fatty replacement, or that it produced infarction and secondary degenerative changes.

Physical Medicine.—Wilson [651] reports on what he calls "an active assistive exerciser" to help correct extension contractures of the knee.

---

648. Cave, E. F.; Rowe, C. R. and Yee, L. B. K.: Chondromalacia of the Patella, Surg., Gynec. & Obst. **81**:446-450 (Oct.) 1945.

649. Soto-Hall, R.: Traumatic Degeneration of Articular Cartilage of Patella. J. Bone & Joint Surg. **27**:426-431 (July) 1945.

650. Cohen, H. H.: Traumatic Degeneration of Medial Head of Gastrocnemius Simulating Semimembranous Bursa: Case Report, J. Bone & Joint Surg. **27**: 720-722 (Oct.) 1945.

651. Wilson, G. D.: Active Assistive Knee Exerciser, Mil. Surgeon **97**:156 (Aug.) 1945.

It uses only passive motion which is induced by means of pulleys and force.

DeLorme [652] in a somewhat new concept of exercises for the knees presents a system of exercises to increase muscular power and endurance. He concludes that low repetition, high resistance exercises produce power and that high repetition, low resistance exercises produce endurance. The indications for each type of exercise vary. He considers that this system of exercises should always precede weight bearing and that it is contraindicated in chondromalacia when open operation has not been performed.

Weakened atrophic muscles should be given power-building exercises first; that is, low repetition, high resistance exercises. When power has been restored, the patient should start on endurance exercises; that is, high repetition, low resistance exercises. Use of both of these forms of exercise should be increased gradually.

Surgical Technic and Results.—Because of a relatively high percentage of recurrence when the standard technics for treatment of recurrent dislocation of the patella were employed, McCarroll and Schwartzmann [653] have abandoned them; namely, (1) transplantation of the lateral half of patellar tendon into the inner surface of the tibia; (2) transplantation of the semitendinosus tendon to the patella and (3) transplantation of the tibial tubercle medially and distally in the shaft of the tibia.

In the place of these procedures they substituted a combined operation in 23 cases with completely satisfactory results and no recurrences to date. The operation consists of transplanting the tibial tubercle and placing the semitendinosus tendon into the patella at the same time. A detailed description of the operative technic is given.

Lapidus [654] reports a successful fusion of a Charcot knee (neurogenic arthropathy of the knee). After removal of synovium and other diseased tissue the ends of the bone were approximated and fused with a vitallium plate, plus two crossed vitallium screws of the wood type. The patient was in a plaster cast for four months postoperatively, and after this a long brace was used on the leg.

Young and Regan [655] review the literature on total patellar excision for arthritis and then present 21 cases in which excision of the patella

652. DeLorme, T. L.: Restoration of Muscle Power by Heavy-Resistance Exercises, J. Bone & Joint Surg. **27**:645-667 (Oct.) 1945.

653. McCarroll, H. R., and Schwartzmann, J. R.: Lateral Dislocation of Patella: Correction by a Simultaneous Transplantation of Tibial Tubercle and Semitendinosus Tendon, J. Bone & Joint Surg. **27**:446-452 (July) 1945.

654. Lapidus, P. W.: A Few Facts Concerning Operative Fusion of Charcot Knee: Report of Case, Bull. Hosp. Joint Dis. **6**:33-40 (April) 1945.

655. Young, H. H., and Regan, J. M.: Total Excision of the Patella for Arthritis of the Knee, Minnesota Med. **28**:909-914 (Nov.) 1945.

was performed for arthritis at the Mayo Clinic. Bilateral excision was performed in 5 cases. The follow-up period after operation was one to four years. Osteoarthritis was present in 14 cases, rheumatoid arthritis in 6 cases and traumatic arthritis from recurrent dislocation of the patella in 1 case.

In 7 of the cases of osteoarthritis excellent results consisting of freedom from pain and a range of motion from at least 90 to 170 degrees occurred. In 4 of the 6 cases of the rheumatoid arthritis, improvement occurred. In 1 case of traumatic arthritis the results were good. Of the 21 patients, 9 said they had no pain after operation, 11 had less pain and 1 was not improved.

Tavernier [656] discusses the stiffness in the knee resulting from traction with Kirschner wire through the femoral condyles. He states that this extension contracture is due to "adhesions below and along the patellar border, anchoring the patella to the femur." He utilizes a midline incision, frees the rectus muscle, separates the patella laterally from the vastus muscles and leaves the patellar tendon intact. The knee is then flexed to a right angle to break the remaining adhesions, and mobilization is started on the fourth or fifth day.

A follow-up study in 19 cases of relaxation of the knee joint has been made by Palmer.[657] In 12 cases operation was carried out for relaxation of the anterior cruciate ligament and medial collateral ligament; in 4 cases for relaxation of the posterior cruciate ligament, and in 3 for relaxation of the collateral ligaments alone. Reenforcement of the ligaments was done with a flap from the iliotibial ligament. In 2 cases histologic studies revealed that the reconstructed ligaments had survived and grown in place. The operative technic is described.

XVIII. CONDITIONS INVOLVING SHOULDER, NECK AND JAW

Prepared by

TOUFICK NICOLA, M.D., MONTCLAIR, N. J.

In 1945 there were a number of papers dealing with conditions involving shoulder, neck and jaw.

Conditions of the Shoulder.—Dislocations: Pettersson [658] discusses the pathology of the dislocated shoulder. He reviews the anatomy of the shoulder joint with special emphasis on the tendon aponeurosis.

---

656. Tavernier, L.: Technique de la cure opératoire des raideurs incoercibles du genou après les fractures du fémur traitées par traction sur broche de Kirschner, Lyon chir. **40**:9-14 (Jan.-Feb.) 1945.

657. Palmer, I.: Plastic Surgery of the Ligaments of the Knee, Acta chir. Scandinav. **91**:37-48, 1944.

658. Pettersson, G.: Rupture of Tendon Aponeurosis of Shoulder Joint in Antero-Inferior Dislocation: Study on Origin and Occurrence of Ruptures, Acta chir. Scandinav (supp. 77) **87**:1-187, 1942.

The physiologic movements of the shoulder joint are described, especially the synchronous movement of "scapulohumeral rhythm." The aid of roentgen rays in diagnosis of rupture of the tendon aponeurosis is illustrated. This is done by the method of Lindbloom (1939) with the use of "perabrodil" (iodopyrin injection). Tears and rents in tendinous cuff have been shown to occur at as early an age as 30 and have been found to increase with age. Some claim that rupture results from trauma; others as a result of progressive degenerative processes.

The after-care of dislocations following reduction is emphasized by Tavernier.[659] Two cases are reported in which a Pouliquen apparatus was used with the arm in 75 degree abduction and in incomplete external rotation.

Magnuson [660] has introduced another operation for recurrent dislocation of the shoulder. He feels that the main cause of recurrent dislocation of the head of the humerus is due to muscular imbalance and not a tear of the capsule, tearing of the anterior lip of the glenoid or even lack of support by the muscles.

He therefore transplants the tendinous attachment of the subscapularis muscle with a wedge-shaped piece of bone from the lesser tuberosity to the greater tuberosity. When the new location for the attachment of the subscapularis muscle is determined, a sharp, thin-bladed chisel is driven into the greater tuberosity, with the edge of the blade held parallel to the long axis of the bone. The chisel is moved back and forth laterally to spread the cancellous bone and leave a wedge-shaped gutter, into which is forced the wedge-shaped piece of bone attached to the subscapularis tendon. The tendon is sutured to the capsule with no. 00 chromic catgut suture, and sutures are repeated on both sides of the wedge so that the sides of the gutter are firmly in contact with the inserted bone. The lower border of the muscle and tendon are then tacked down with interrupted sutures far enough under the head of the humerus so that the muscle and capsular tendon have a firm grip around the head, with no tendency to slip up toward the coracoid process and the glenoid when the arm is brought into abduction and external rotation.

[Ed. Note.—The author shows no proof for the statement that recurrent dislocations are due to muscular imbalance and not to a tear of the capsule from the anterior lip of the glenoid.]

Kunz [661] reviewed the technic of the Nicola operation with a modification employed by Nicola. Emphasis is placed on the proper place-

659. Tavernier: After-Care of Luxations Following Reduction, Lyon chir. **37**:345-348, 1941-1942.

660. Magnuson, P. B.: Treatment of Recurrent Dislocation of Shoulder, S. Clin. North America **25**:14-20 (Feb.) 1945.

661. Kunz, H. G.: Nicola Operation, Mil. Surgeon **96**:429-432 (May) 1945.

ment of the tunnel through the head of the humerus, reenforcement of the long head of the biceps with a strip of the coracohumeral ligament and securing the tendon in the tunnel.

Bush [662] describes a modification of the Nicola operation for recurrent dislocation of the shoulder. The biceps tendon and bicipital groove are exposed through the usual incision and the tendon retracted without dividing it. The bicipital groove is then deepened with a gouge or osteotome to form a channel ½ inch (1.27 cm.) deep extending ½ inch above the anatomic neck to the point of exit of the bicipital tendon from its sheath. The tendon is replaced and a tension suture is placed through the tendon and the fascia and its distal exit from the channel. The tendon sheath is closed over the tendon. Further stability is obtained by plicating the anterior capsule. The arm is immobilized for three weeks, at which time graduated exercises are begun, reaching full use in eight weeks. The technic has been used on 20 patients, with no recurrences at the end of several weeks. Only 2 patients have been followed for over one year, with no recurrences.

Asplund [663] reports a case of bilateral voluntary posterior dislocation of the shoulder in a youth, aged 18, who showed tendency to luxations in some other joints. One of the shoulders has been surgically treated with a good result by bone grafting.

Orell and Petrén [664] present a treatment for recurrent dislocations by bone grafting. Their method consists of inserting os purum peg into a slot made on the neck of the scapula just medial to the rim of the glenoid cavity just below the middle of the rim of the glenoid. Special instruments to create the slot and insert the lamella are used. Anatomic observations are described showing methods of surgical approach to the neck of the scapula. Avoidance of injury to muscles, tendons, vessels and nerves is demonstrated. The operation is all extra-articular.

Ricard, Clavel and Francillon [665] report a case of recurrent dislocation of the shoulder treated by the Oudard operation followed by a fracture of the coracoid process at the end of three years. This case was then successfully treated by a Hybinette type of operation in which a bone graft is inserted just medial to the anterior lip of the glenoid on the neck of the scapula.

---

662. Bush, L. F.: Dislocations of Shoulder, Am. J. Surg. **67**:520-523 (March) 1945.

663. Asplund, G.: Habitual-Voluntary Posterior Luxation: Case with Recovery Following Bone Graft, Acta chir. Scandinav. **87**:103-112, 1942.

664. Orell, S., and Petrén, T.: Anatomic Observations in Treatment of Recurrent Dislocation of Shoulder Joint by Bone Grafting, Acta chir. Scandinav. **87**:286-297, 1942.

665. Ricard; Clavel, and Francillon: Recurrent Luxation: Oudard Operation Followed by Fracture of Coracoid Process at End of Three Years; Preglenoid Bone Graft, Lyon chir. **37**:331-335, 1941-1942.

Bicipital Tendovaginitis: Bicipital tendovaginitis is relatively common in young males engaged in strenuous activities.[666] This may be due to the constant movement and overuse of the tendon as it arches over the head of the humerus. The authors feel that because of this the tendon falls prey to infection. They found that the right shoulder is more commonly affected in right-handed persons. The condition responds to infiltration—first with 10 cc. of 1 per cent procaine hydrochloride in and about the tendon and tendon sheath and then with 15 cc. of isotonic solution of sodium chloride injected in the same areas. After the immediate relief there is an increase of symptoms for the first twenty-four to forty-eight hours.

Tendogenetic disease, according to Borak,[667] may be treated successfully with roentgen rays. Healing wounds under the influence of roentgen rays show that the amount of fibrin between the edges of the wound is much less in the irradiated wound. The roentgen rays do not dissolve the fibrin but dilate the capillaries and increase their permeability. Roentgen rays in small doses may cause the disappearance of calcified deposits in cases of acute disease, while large doses are required in cases of chronic disease. The roentgen rays have a direct action not on the calcium deposits but on the underlying inflammatory process. It is the postradiation edema carrying phagocytic cells which causes the dissolution of the calcium deposits.

The author places his cases in three groups: Group 1 is marked by complete, or nearly complete, immobilization of the affected part. The pain sets in suddenly and is intense, producing a strong spasm, so that the arm is adducted to the body. This group is treated with 100 r, given on two or three successive days to prolong the duration of the postradiation edema and thus increase the cells functioning as phagocytes. Group 2 is marked by restriction of the mobility of the affected arm. The arm is not fixed, as in the first group, but can be abducted 40 to 60 degrees. This group is treated with 200 r given six to eight times at intervals increasing from two to four days. The portals of entrance, one anterior and one posterior, are required in these cases. After a month a new series of treatment is added, if necessary, until the deposit is reduced in size and density and the pain on moving the arm has subsided. Group 3 is marked by lack of any restriction when the shoulder is moved actively, but pain is experienced at the extremes of the range of motion when the arm is raised over 80 degrees. The muscles are not spastic but may become atrophic. This group is treated by doses of 250 r given eight times at intervals of two days.

666. Kaplan, I. W., and Hawkins, B. L.: Bicipital Tendovaginitis, Am. J. Surg. **70**:383-385 (Dec.) 1945.

667. Borak, J.: Tendogenetic Disease and Its Treatment with X-Rays, New York State J. Med. **45**:725-729 (April 1) 1945.

Kabat [668] claims relief of pain in subacromial bursitis by subcutaneous injections once or twice daily of 2 cc. of neostigmine methylsulfate in a $\frac{1}{2,000}$ solution (1 mg.) plus $\frac{1}{100}$ grain (0.65 mg.) or $\frac{1}{150}$ grain (0.43 mg.) of atropine sulfate. The atropine is used to eliminate the unpleasant parasympathetic side effects of the neostigmine.

Howorth [669] exposed the bursas and calcareous deposits in 23 shoulders. The calcareous deposit in all the cases was in the tendinous cuff and had ruptured into the bursa in only 1 case. The character of the deposit varies from a milklike fluid to a dry granular material. The tendon adjoining the deposits was degenerated and often infiltrated with small masses of calcareous material.

The cause of the condition is obscure, but the author considers that the pressure of the supraspinatus tendon against the head of the humerus with the arm at the side, plus sudden, resisted movements, creates sufficient pressure against the tendon to produce degeneration and eventual calcification.

Results of the operative evacuation were uniformly good in early cases with liquid deposit, only fair in chronic cases. In all cases in which manipulation was attempted preoperatively, the condition became worse.

Operative removal is the preferred treatment in cases of chronic disease, and, while uniformly successful as in cases of acute disease, it offers greater relief than physical therapy, roentgen rays or injection.

In cases of acute disease, relief may be obtained by rest, heat, diathermy, cold, ethyl chloride spray or roentgen therapy. However, operative removal gives the most prompt relief and assures permanent healing of the lesion.

Neviaser [670] studied the pathologic changes in periarthritis of the shoulder through the surgical exploration of the shoulder joint in 10 cases and through dissection of 63 shoulders in the autopsy room.

None of the 10 cases showed pathologic changes in the subacromial bursa on gross examination, but varying degrees of inflammatory change were found microscopically in 7 cases.

The capsule in 9 cases was contracted and closely adherent to the humeral head at its anterior, inferior portion. There were also adhesions in the reflected fold distal to the anatomic head.

All adhesions were freed and normal motion was restored by manipulation. These observations were confirmed on autopsy specimens.

---

668. Kabat, H.: Neostigmine Therapy of Sub-Acromial Bursitis, Pub. Health Rep. **59**:1635-1650 (Dec. 22) 1944.

669. Howorth, M. B.: Calcification of Tendon Cuff of Shoulder, Surg., Gynec. & Obst. **80**:337-345 (April) 1945.

670. Neviaser, J. S.: Adhesive Capsulitis of Shoulder: Study of Pathologic Findings in Periarthritis of Shoulder, J. Bone & Joint Surg. **27**:211-222 (April) 1945.

The author concludes that the essential pathologic change is an "adhesive capsulitis," that full motion may be restored by manipulation with the patient under anesthesia and that the term "periarthritis" should be abandoned.

A new traction device for the treatment of the so-called frozen shoulder is presented by Stein.[671] It consists of an inverted Blake board suspended from a Balkan frame. A system of pulleys is used whereby the patient can do his own manipulation by pulling or sliding the ropes in the system. The range of motion of the shoulder can be made complete from adduction to abduction.

The patient is placed on two mattresses and the pillow for his head is placed at the foot of the bed to allow for complete abduction of the shoulder.

Shoulder Girdle.—Bloom[672] emphasizes the reason for failure of operative procedures in the acromioclavicular separation which attempt to produce a fixed union at the joint. Loss of ability of the clavicle to rotate interferes with abduction. For this reason, rigid fixation material should be used only with the knowledge that it must be removed after healing has occurred.

The author describes a method of maintaining reduction of the joint by means of a towel clamp inserted in drill holes placed in the outer end of the clavicle and the acromium. The author uses the Murray closed method of insertion of wires across the joint. Twelve cases are reported with good results following routine removal of the fixation wires sixty days after insertion.

Dorling[673] reports 2 cases of dropped shoulder and winged scapula. In 1927 Professor Arnold K. Henry described an operation for slinging a dropped shoulder. The condition followed division of the spinal accessory nerve during an operation for tuberculous glands of the neck eighteen months before. It was successfully treated by slinging the scapula to the spines of the sixth cervical and third dorsal vertebrae by means of fascial strips from the thigh.

The author modified Henry's original method by turning up a single flap instead of making four separate incisions, and in the case of the dropped shoulder by slinging up the outer border of the clavicle as well as the scapula. The after-treatment was also simplified.

The technic of the operation consisted of passing strips of fascia lata through two drill holes in the vertebral border of the scapula, passing

671. Stein, R. O.: Shoulder-Ankylosis-Swinging Traction Suspension Apparatus: New Shoulder Mobile Traction, Bull. Hosp. Joint Dis. **6**:26-28 (April) 1945.

672. Bloom, F. A.: Wire Fixation in Acromioclavicular Dislocation, J. Bone & Joint Surg. **27**:273-276 (April) 1945.

673. Dorling, G. C.: Fascial Slinging of Scapula and Clavicle for Dropped Shoulder and Winged Scapula, Brit. J. Surg. **32**:311-315 (Oct.) 1944.

around the spinous processes of the sixth cervical and third thoracic spinous processes. A skeletal abduction plaster was applied including a pelvic band and a plaster armcuff connected by two plaster struts anteriorly and posteriorly.

Kuhns [674] reports on the variations in the vertebral border of the scapula. He states that there are three types of vertebral borders of the scapulas: concave, straight and convex. Thus the results of muscular action on the scapula, as a continued strong pull upward and outward, can produce a convex vertebral border. Powerful action of the serratus anterior, the pectoralis major and the latissimus dorsi may bring this about. The change from a concave to a straight vertebral border was frequently observed in growing children. No important clinical significance is attached to these scapular variations.

Other Conditions of the Shoulder: Behrens [675] enumerates the readily recognized causes of pain in the upper extremity, disability and abnormal sensation, including contusions, sprains, fractures, dislocations, acute infections, rheumatic fever and calcium deposits in the shoulder cuff.

In the more obscure cases, the author advises roentgen studies of the cervical spine and the upper thorax. Occasionally, such unusual conditions as vertebral or cord tumors, infectious processes, extensive synosteoses or cervical ribs will be found. More often, arthritic changes in the cervical vertebrae and thinning of the intervertebral disks will be found. The importance of both hypertrophic changes and thinning of the disks in producing pain in an upper extremity is emphasized, although the degree is not always directly proportional to the severity of symptoms.

These cases do not respond to the usual methods of medical treatment or diathermy. Manipulation, traction and massage are helpful, but roentgen therapy is most effective.

The mode of action of roentgen therapy is one of substitution of active circulation for passive congestion associated with low grade inflammatory conditions.

In cases of cervical arthritis and thinned disks the influence of roentgen rays is on the irritated and congested soft tissues of the affected segments. Reduction of swelling and improvement of the circulation reduce pressure on nerve roots with resultant improvement in symptoms. In cervical arthritis, the improvement is slow, as compared with calcific lesions of the shoulder cuff. Pressure symptoms due to arthritic spurs will not improve.

674. Kuhns, J. G.: Variations in Vertebral Border of Scapula: Relation to Muscular Function, Physiotherapy Rev. **25**:207-210 (Sept.-Oct.) 1945.

675. Behrens, C. F.: Roentgenologic Considerations Pertaining to Upper Extremitiy Pain, J. A. M. A. **127**:888-890 (April 7) 1945.

Slobe [676] discusses the reflex pain in the arm secondary to fibromyositis of the shoulder girdle and back. The mechanism of the referred pain is apparently due to local areas of induration and infiltration constituting "trigger zones" acting as foci of irritation as a result of which pain is referred reflexly to distant parts. They are treated by the injection of 10 cc. of 1 per cent procaine hydrochloride without epinephrine into the local tender area. Repeated injections are given at intervals of from one to four days.

Evans and Krahl [677] have made a phylogenetic survey of the humerus from fish to man. Anatomists have been cognizant of the twisted appearance of the humerus since the middle of the nineteenth century. There is a difference between torsion of the humerus and rotation of the humerus. Rotation is turning the humerus about its long axis, a motion which does not change the relationship of the opposite ends of the bone to each other. An instrument, torsiometer, was used. Humeral torsion, which first appears in labyrinthodonts and is retained by all later terrestrial tetrapods with forelegs, is the result of an evolutionary or hereditary (primary) torsion on which is superimposed an ontogenetic (secondary) torsion produced by muscular forces. Torsion of the humerus has occurred in a medial direction.

Osteochondritis dissecans of the supratrochlear septum of the humerus is discussed by Crysler and Morton.[678] They describe it as a localized lesion of the intra-articular portion of the supratrochlear septum of the humerus. It was previously confused with sesamum cubitis.

There may be a supratrochlear foramen or thin septum in the opposite humerus. Local impingement of the coronoid or the olecranon process may be a contributory primary agent. The condition may be due to a vascular abnormality during growth.

Symptoms may exist or remain subclinical for a considerable time. The minimal traumas associated with the onset of clinically noticeable symptoms cannot be considered the major causative agent. The nucleus may be extended as a loose body into the elbow joint. Surgical removal is the treatment.

The Neck.—Davis [679] reviews the functional anatomy of the cervical part of the spine, emphasizing the importance of straightness of the cervical part when there is no obvious fracture or dislocation.

---

676. Slobe, F. W.: Reflex Phenomena in Arm Secondary to Fibromyositis of Shoulder Girdle and Back, Proc. Interst. Postgrad. M. A. North America (1944), 1945, pp. 236-239.

677. Evans, F. G., and Krahl, V. E.: Torsion of Humerus: Phylogenetic Survey from Fish to Man, Am. J. Anat. **76**:303-337 (May) 1945.

678. Crysler, W. E., and Morton, H. S.: Osteochondritis Dissecans of Supra-Trochlear Septum of Humerus, Am. J. Roentgenol. **54**:41-46 (July) 1945.

679. Davis, A. G.: Injuries of Cervical Spine, J. A. M. A. **127**:149-156 (Jan. 20) 1945.

Spasm of the cervical musculature holds the spine in the staightened position to avoid painful contact with injured facets or the capsule of facets. Subsequent roentgenograms with the cervical part of the spine in extreme flexion will seem to localize the lesion by demonstrating forward luxation permitted by rupture of the articular capsule and the posterior common ligament. Further localization is shown by root distribution of pain and muscular spasm.

These patients should be treated with a hyperextension collar for a minimum of three weeks to allow repair of fibrous tissue and prevent chronic disability.

The management of obvious lesions, fracture or dislocation, is reviewed with emphasis on immediate traction and early laminectomy when subarachnoid block is demonstrated.

Lyon [680] reviews 40 cases showing localized hypertrophic lesions peculiar to the cervical part of the spine and the body of the first thoracic vertebra which he terms "uncovertebral osteophytes" and to which he attributes neuralgic symptoms referred to the arms, the neck and the back of the head.

The lesions are described as hypertrophic spondylitis (marginal bony proliferations) due to degenerative changes of the annulus fibrosus and arthrosis deformans of the posterior articulations with osteophytes protruding into the intervertebral foramina, producing pressure symptoms. A further cause of marginal proliferations is osteochondrosis of the cervical part of the spine with degenerative changes of the disk and body and secondary osteophytes.

Clinically, patients complained of boring brachial pain, radiating to arms, pain in the back of the neck and the head, and occasionally dizziness, tinnitus, ear ache, dysphonia and transitory swelling of the arm. Muscular strength was impaired, but sensory disturbances were rare. Treatment is palliative.

Browder and Watson [681] review 22 cases with compression of the cervical part of the cord and spinal root caused by herniation or protrusion of a part of an intervertebral disk.

Three different types of pathologic processes were encountered: (1) discrete, oval or rounded nodules projecting into the ventral vertebral canal; (2) true dorsal herniations of the nucleus pulposus, and (3) ridges of the annulus fibrosus surrounding hypertrophic bone at the margins of the adjacent vertebra.

A negative reaction to the Queckenstedt test does not rule out the presence of such a lesion.

---

680. Lyon, E.: Uncovertebral Osteophytes and Osteochondrosis of Cervical Spine, J. Bone & Joint Surg. **27**:248-253 (April) 1945.

681. Browder, J., and Watson, R.: Lesions of Cervical Intervertebral Disk: Clinicopathologic Study of Twenty-Two Cases, New York State J. Med. **45**: 730-737 (April 1) 1945.

Davies [682] states that the pantopaque visulization by the Spurling-Scoville method of the canal of the cervical part of the spine revealed lateral herniation of the nucleus pulposus in 4 cases. Symptoms of pressure on the cervical nerve roots were present in these 4 cases. The articular space was diminished at the site involved.

Elliott and Kremer [683] reported on 8 cases of brachial pain from herniation of the cervical intervertebral disk. They showed uniform distribution of pain in the back of the shoulder, down the back of the arm and the radial border of the forearm, and sometimes in the upper pectoral region. There were areas of paresthesia in the thumb, the index and the middle finger. In some cases there was a history of acute stiff neck.

The signs included limitation of movement of the neck, pain produced in the arm by movements of the neck and by downward pressure on the head and tenderness, weakness and wasting of the upper fibers of the pectoralis major, the triceps and the extensors of wrist and fingers. The triceps jerk was reduced or absent, and there was usually hypoalgesia on the thumb and the index finger.

The clinical picture was that of a lesion of the seventh cervical root by herniation of the sixth cervical intervertebral disk.

Love [684] discusses the scalenus anticus syndrome with and without a cervical rib.

The diagnosis is made on: (1) a history of pain, atrophy, circulatory abnormalities, disturbance of sensation and paresthesia in the upper extremity; (2) reduction or obliteration of the radial pulse when scalenus muscle is put on tension, as in extending the neck with the head turned to the affected side when taking a deep breath (Adson maneuver), and (3) the fact that pain is usually felt along the inner side of the arm in the course of the internal cutaneous, the ulnar and the median nerves.

The author states that not all patients with the cervical ribs require treatment. In the conservative treatment the load on the shoulder girdle is lessened; there is application of heat locally; the patient is instructed to sleep with the hands over the head or prone with the arms over the sides of a narrow bed, and acetylsalicylic acid is used. The radical treatment consists of division of the scalenus anticus muscle with or without the removal of the cervical rib.

---

682. Davies, H.: Lateral Prolapse of Cervical Intervertebral Disk, Brit. J. Radiol. **18**:1-4 (Jan.) 1945.

683. Elliott, F. A., and Kremer, M.: Brachial Pain from Herniation of Cervical Intervertebral Disk, Lancet **1**:4-8 (Jan. 6) 1945.

684. Love, J. G.: Scalenus Anticus Syndrome with and without Cervical Rib, Proc. Staff Meet., Mayo Clin. **20**:65-70 (March 7) 1945.

Cervical ribs [685] occur in 1 per cent of all persons but give symptoms only in 5 to 10 per cent of the cases. The symptoms are due to compression of the brachial plexus and sometimes of the subclavian artery, too, between the cervical rib or its fibrous continuation and the scalenus anticus. Of 12 patients, 10 were women.

Symptoms of pain, lessened power, impaired sensation, paresthesia and sometimes a sensation of chilliness are present.

Scalenotomy, division of ligament, resection or partial removal of the cervical rib were types of operative procedures used.

Walshe, Jackson and Wyburn-Mason [686] also discuss the anatomic, pathologic and physiologic changes in cervical rib abnormalities. They stress the damage to the subclavian artery which may lead to its aneurysmal dilatation with or without formation of a clot within it. Thrombosis may occur leading to ischemia and gangrene of the fingers.

The Jaw.—Converse [687] shows a modification of the previous Converse-Waknitz external fixation apparatus for fractures of the mandible. It is smaller and lighter. It has a jackscrew which permits variations of distance between twin pin units.

Lateral variations of each pin unit are also possible as in the anginal appliance. The small universal joints are modifications, of a smaller size, of the joints utilized by Clouston-Walker.

Rushton and Walker [688] describe the uses of the Clouston-Walker screw pin in cases of (1) mandibular fractures without loss of bone for the fixation of fragments which have few or no teeth and which are or may become displaced; (2) as a fixation of bone grafting the mandible, where it is especially valuable in maintaining a displaced ascending ramus in its corrected position, and (3) as a fixation for the malar bone when owing to delay in correction it has become fixed in a bad position.

Other uses illustrated are to prevent deviation of the remains of a mandible and indirectly to support a loose maxilla.

Elvidge and Baxter [689] discuss the treatment of multiple fractures of the facial bones with an external pin fixation splint which is a modification of the Roger Anderson splint. It can be used in cases

685. Prytz, D.: Cervical Rib, Acta psychiat. et neurol. **19**:301-319, 1944.

686. Walshe, F. M. R.; Jackson, H., and Wyburn-Mason, R.: Pressure Effects Associated with Cervical and Rudimentary and "Normal" First Ribs and Factors Entering into Their Causation, Brain **67**:141-177 (Sept.) 1944.

687. Converse, J. M.: Appliances for External Fixation of Mandible and Cranial Fixation of Maxilla, Am. J. Orthodontics (Oral Surg. Sect) **31**:111-112 (Feb.) 1945.

688. Rushton, M. A., and Walker, F. A.: Uses of Screw-Pin in Maxillofacial Cases, Brit. Dent. J. **78**:289-292 (May 18) 1945.

689. Elvidge, A., and Baxter, H.: Treatment of Multiple Fractures of Facial Bones with External Pin Fixation Splint, McGill M. J. **13**:469-475 (Dec.) 1944.

in which there is associated fracture of the cranium or severe injury to the brain in which a craniotomy may be necessary. The splint may be applied to the cranium at a distance from the cranial fracture so that extensive lacerations or severe hematomas can be attended to without disturbing the fixation of the facial fractures.

No plaster of paris caps are used, as they are clumsy, nonrigid and uncomfortable and may cause pressure sores.

The operation may be carried out early and splints are applied with the patient under local anesthesia. Associated fractures of the zygomatic nasal and mandibular bones may be reduced and retained in position by extension bars from the main splint which supports the maxilla.

Thoma [690] reviews the history of the treatment of the mandibular condyle from the time of Desault. A classification of the types of fractures of this bone is presented. He reports 32 cases of such fractures; 5 were bilateral and 22 were unilateral. In 16 cases other mandibular fractures were present.

Conservative treatment is inadequate as a result of ensuing pain, limited motion and malocclusion.

In children, due to epiphyseal growth, better results followed conservative treatment, but in adults operative procedures were found necessary for satisfactory end results.

Open operative wiring of fragments was advocated in cases of wide separation or marked overriding and displacement of the condyle.

Walker [691] presents a screw pin for use in connection with mandibular fractures and grafts. A thicker and more rigid pin is used in contrast to the thinner pins previously used in the Clouston-Walker apparatus for fractures of the mandible.

690. Thoma, K. H.: Fractures and Fracture Dislocations of Mandibular Condyle: Method for Open Reduction and Internal Wiring and One for Skeletal Fixation with Report of Thirty-Two Cases, J. Oral Surg. **3**:3-59 (Jan.) 1945.

691. Walker, F. A.: Screw-Pin for Use in Connection with Mandibular Fractures and Grafts, Brit. Dent. J. **78**:266-267 (May 4) 1945.

REVIEW OF UROLOGIC SURGERY

ALBERT J. SCHOLL, M.D.
LOS ANGELES
FRANK HINMAN, M.D.
SAN FRANCISCO
ALEXANDER B. HEPLER, M.D.
SEATTLE
ROBERT GUTIERREZ, M.D.
NEW YORK
GERSHOM J. THOMPSON, M.D.
AND
EDWARD N. COOK, M.D.
ROCHESTER, MINN.
JOHN F. FLYNN, M.D.
LOS ANGELES
AND
VINCENT J. O'CONOR, M.D.
CHICAGO

KIDNEY

Hydronephrosis.—Hinman [1] discusses the various problems and types of surgical treatment in hydronephrosis. He states that the only cure is removal of the obstruction causing the condition and that, therefore, the first step in treatment is to determine the cause, degree, complexity and site of the obstruction. The condition of the renal parenchyma must be determined as, in addition to hydronephrotic atrophy, acute, chronic or atrophic pyelonephritis may be present which would cause progressive loss of renal function even after removal of the obstruction. The aim in treatment is preservation of renal tissue with the least risk.

In ureteropelvic obstruction, if an uninfected hydronephrotic kidney is capable of performing a fifth to a fourth of total function and reserve potentialities exist there is good reason to attempt plastic repair; otherwise, nephrectomy is indicated. If hydronephrosis is bilateral nephrectomy should be performed only when a kidney is functionless. If repair is indicated it is best to repair the poorer side first because (1) postoperative renal insufficiency and the danger of anuria will be less and (2) optimal repair of both kidneys will be secured. The repaired poorer

1. Hinman, F.: Hydronephrosis: IV. The Surgical Treatment, Surgery **20**:337-359 (Sept.) 1946.

kidney is stimulated to build up its reserve during the period of lessened function following repair of the better kidney. The second operation should not be delayed too long, as delay alters the potentialities for increasing the function of each kidney. Plastic repair in hydronephrosis may consist of (1) pelvioureterolysis, (2) incision and closure of the stenosed portion with or without plication or partial pelvectomy, (3) reimplantation of the ureter into the pelvis, often with plication or partial pelvectomy or (4) one or more of these methods combined with use of a ureteral splint, nephrostomy or pyelostomy, nephropexy or denervation of the renal pedicle. An excellent group of drawings demonstrating these procedures is presented. The method to be used can be decided on satisfactorily only after the kidney and ureter have been well exposed and the situation carefully studied. In exposing the kidney it is important that the line of cleavage be back of the retrorenal fat, leaving the quadratus lumborum and the psoas muscles cleanly uncovered. The posterior surface of the kidney cleaned down to its capsule adheres firmly to these muscles later. In pelvioureterolysis the surgeon must decide whether or not to preserve aberrant arteries; the veins are rather unimportant. Hinman is of the opinion that following the plastic repair, drainage by means of nephrostomy and ureteral splint is usually the method of choice. The splint need not be left for more than seven to twelve days. Troublesome infection is negligible when urinary antiseptics are used.

In treatment of hydronephrosis caused by obstruction below the ureteropelvic junction (ureteral, vesical or urethral obstruction) removal of the obstruction which may be caused by stone, stricture, prostatism or posterior urethral valves usually suffices. Secondary changes, such as vesical diverticulum, ureterovesical stenosis or valve formation by an elongated tortuous ureter, may give rise to obstruction and require treatment.

Anomalies.—Way and Popper [2] present a case of four urologic anomalies in which the patient was a soldier, 30 years old, who had died of postoperative complications after a gastric operation. The anomalies were: (1) reduplication of the right kidney and ureter, (2) ectopic opening of the ureter from the upper segment of the right kidney into the right seminal vesicle, (3) aplasia of left kidney and (4) rudimentary segment of left ureter located between the left seminal vesicle and the ductus deferens.

Stones.—Anderson [3] found microscopic renal calculi in each of 170 diseased or grossly normal kidneys at necropsy. All the kidneys were

2. Way, R. A., and Popper, H.: Four Urological Anomalies in One Person, J. Urol. **55**:454-459 (May) 1946.

3. Anderson, L.: Microscopic Renal Calculi, Proc. Staff Meet., Mayo Clin. **21**:326-329 (Aug. 21) 1946.

removed from patients who had been more than 9 years of age at the time of death. Some of the calculi were located just under the epithelium at the tip of the papilla and some were noted to be ulcerating through this epithelium.

Since the work of Randall it has been fairly well accepted that some renal calculi are formed when the salts of the urine in the renal pelvis are deposited in layers on grossly visible plaques attached to the tip of the papilla. Perhaps these so-called Randall plaques were formed by the deposition of the salts of the urine on the nidus of these microscopic calculi.

Apparently almost every one has a microscopic calculus which could erode through the epithelium at the tip of the papilla and act as a nidus for the formation of a plaque and then a stone. It may be that some substance appears in the urine or blood which acts as a catalyst which causes the salts of the urine to be precipitated on the nidus, or perhaps the unknown substance causes the epithelium to ulcerate and expose the tiny calculus to the salts of the urine. It is conceivable that the answer lies outside the kidney. The absence of some vitamin-like substances or the presence of some other known or unknown substance from the general metabolism of the body or from the diet might be a causative factor. In Anderson's opinion large or symptomatic renal calculi are the result of a systemic process or dietary disease rather than of a disease of the kidney.

Gersh and Meltzer [4] state that xanthine calculi are surprisingly rare. Only 19 cases have been reported up to the present time. These authors report 2 cases in which the patients were soldiers, aged 31 and 41 years, respectively. The calculus from the first patient was a combination of calcium and xanthine, and the patient stated that he had been taking alkalis for one year to combat gastric hyperacidity. The prolonged production of alkaline urine probably created a favorable condition for the production of a xanthine-cation compound. In the second case the urine was persistently acid and the calculus was "pure" xanthine. The findings in this case confirm the fact that xanthine and other purine compounds are less soluble in acid than in alkaline solutions. The appearance of xanthine calculi at roentgenologic examination is apparently variable. In these 2 cases evidence of the calculi was not found at roentgenologic examination.

Dees [5] discusses the reasons for incomplete surgical removal of renal calculi. A new technic for surgical removal of renal stones is described. The purpose is to insure more fully the complete removal of free renal

4. Gersh, I., and Meltzer, H. L.: Xanthine Urinary Calculi: Report of Two Cases, J. Urol. **55**:169-172 (Feb.) 1946.

5. Dees, J. E.: The Use of a Fibrinogen Coagulum in Pyelolithotomy, J. Urol. **56**:271-283 (Sept.) 1946.

stones, as well as to reduce the trauma to which the kidney is subjected at operation.

An intrapelvic coagulum is formed by the simultaneous injection of thrombin and human fibrinogen into the renal pelvis. This coagulum theoretically incorporates within itself all free calculi present, regardless of size or location, and on withdrawal of the coagulum through a pyelotomy the stones are removed.

Within the limitations of the technic the results were excellent in 28 cases, partially satisfactory in 6 cases and unsatisfactory in 2 cases. Failure in 5 additional cases was attributed to technical difficulties.

Ellik [6] presents a case of stone in the renal pelvis in which removal was accomplished by cystoscopy and use of the Balkus modification of the Zeiss looped catheter. The patient was a naval officer, 32 years old. The stone, which measured about 1.25 by 0.75 cm., was caught in the loop of the catheter in the renal pelvis and gradually brought down through the ureter in a five day period.

Tumors.—Deming [7] states that the prognosis in cases of malignant renal tumor is much poorer than is indicated by reports of five year follow-up studies. In his study of a series of 82 cases he found that 19.5 per cent of the patients lived five years, 14.6 per cent lived ten years, and 9.08 per cent were living without evidence of tumor at the time of his report. The fact that some died of the disease after the tenth year would indicate that even after ten years it cannot be assumed that a cure of a malignant renal tumor has been obtained.

The problems are manifold, embracing hereditary, congenital and acquired factors. Biologic proof, in addition to gross and microscopic evidence of malignancy in a renal tumor, must be obtained. Individual defensive measures on the part of the host against the development of renal neoplasms are probably a natural response. It is doubtful whether, in the so-called controlled cases in Deming's series, the malignancy of the tumors would have been proved by both the pathologic and biologic tests. Recovery of the patients can be explained in addition to surgical treatment, either on the basis of nonmalignancy of the tumor as proved by biologic tests or on the basis of natural factors of defense. Since surgical treatment and irradiation promise little other than control of less than 10 per cent of renal tumors, little improvement can be expected in the end results until some of the problems can be solved.

Hamm [8] reports a case of angioma of the kidney in which the tumor was large enough to produce pyelographic evidence of a filling defect

6. Ellik, M.: Cystoscopic Transurethral Extraction of a Stone Located in the Renal Pelvis, J. Urol. **56**:46-48 (July) 1946.

7. Deming, C. L.: The Prognosis and Problems in Renal Tumors, J. Urol. **55**:571-582 (June) 1946.

8. Hamm, F. C.: Angioma of the Kidney, J. Urol. **55**:143-148 (Feb.) 1946.

which simulated that of papilloma of the renal pelvis. The patient was a white man, 34 years old, who complained of pain in the left renal region and gross hematuria. Cystoscopy and pyelograms revealed bloody urine from the left kidney and a small filling defect in the upper calix of the left kidney. Only the upper pole of the left kidney was removed because function of the right kidney was diminished. Subsequent pathologic examination revealed a small dark-colored tumor about 4 mm. in diameter contiguous to a papilla of a posterior, superior calix and attached to the pelvic mucosa by a broad pedicle. Microscopic diagnosis was angioma.

Ney [9] presents 10 cases of tumor thrombosis of the inferior vena cava associated with malignant renal tumors. These bring the total reported in the literature to 51. An analysis of the cases reported in Ney's paper substantiates the following previously stated facts. Renal tumors are by far the most common malignant tumors associated with tumor thrombosis of the inferior vena cava. The thrombus usually has extended from the renal vein (42 cases of the 51). In many of the cases (35) the malignant lesion was in the right kidney, probably because the renal vein on the right is short. Tumors occur predominantly in men (in 42 cases). Many (20) have extension of the thrombus into the right auricle.

In Ney's paper the following points are stressed; several are in disagreement with those stressed in other reports. Edema of one or both extremities is associated with thrombosis of the inferior vena cava so commonly that the diagnosis of tumor thrombosis can be made with a fair degree of certainty in cases of malignant renal tumors in which edema of the extremities is present. Direct invasion of the inferior vena cava is an important cause of thrombi. The direction of the extension of the thrombus is not controlled entirely by the flow of blood. Patients with tumor thrombosis of the inferior vena cava appear to be seriously ill and rarely live more than six months after signs of obstruction have occurred.

Bandler and Roen [10] report a case of testicular metastasis from hypernephroma of the kidney; such metastasis rarely occurs.

Unusual features of this case were that the testicular metastasis antedated the clinical detection of hypernephroma by two years, that this was a solitary metastatic lesion so far as could be ascertained and that the patient was well three and one-half years after orchicctomy and one year following nephrectomy. The testicular tumor was erroneously

9. Ney, C.: Thrombosis of the Inferior Vena Cava Associated with Malignant Renal Tumors, J. Urol. **55**:583-590 (June) 1946.

10. Bandler, C. G., and Roen, P. R.: Solitary Testicular Metastases Simulating Primary Tumor and Antedating Clinical Hypernephroma of the Kidney: Report of a Case, J. Urol. **55**:663-669 (June) 1946.

believed to be a rare primary neoplasm in the two years which preceded the clinical recognition of the renal tumor.

This case proves again that the presence of a solitary metastatic lesion is no contraindication to operation in hypernephroma.

Metastasis in general and a possible mode of transmission in this case are discussed.

Everett and Wayburn [11] report a case of diffuse infiltration of the renal pelvis and entire ureter by so-called Brunn's cell nests. In one portion of the kidney the picture presented was highly suggestive of extremely early squamous cell carcinoma. This would seem to indicate an etiologic role of such cell nests in the production of carcinoma as previously suggested by other investigators.

A brief review of the literature and a cursory examination of material in the Department of Pathology of the Johns Hopkins Hospital would suggest that subepithelial cell nests in the renal pelvis, ureter and bladder are by no means rare.

These findings may offer an explanation of the tendency of papillary tumors of the pelvis, ureter or bladder to be multiple and of malignant tumors of the pelvis or ureter to recur in any portion of the ureter not removed.

Pfeiffer and Gandin [12] state that massive perirenal lipoma must be considered in the diagnosis of immense abdominal tumors and included among those amenable to surgical treatment. This relatively uncommon, pathologically benign tumor, occurring more frequently in women, is characterized by insidious onset, tremendous enlargement of the abdomen, symptoms arising from pressure on neighboring structures, a tendency to malignant degeneration and recurrence after surgical removal, resulting in cachexia and death. If the tumor becomes malignant it usually becomes a fibroliposarcoma. True perirenal lipomas originate from the renal capsule or perirenal fat. However, they may arise from the mesentery or omentum. They are found most commonly in patients between the ages of 40 and 60 years. Diagnosis is made by means of pyeloureterograms in which distortion of the course of the ureter and dislocation of the kidney are considered to be diagnostic. Evidence of dislocation of the intestinal tract as seen on roentgenologic examination of the gastrointestinal tract may contribute to diagnosis. Treatment consists of surgical removal of the tumor. Nephrectomy is indicated when the kidney is intimately adherent to the tumor and when atrophy is present. The operative mortality rate is approximately 20 per cent. The ultimate prognosis is grave because recurrences are frequent and the recurrent tumors tend to undergo malignant degeneration.

---

11. Everett, H. S., and Wayburn, G. J.: A Unique Case of Submucosal Epithelial Nests in the Ureter and Renal Pelvis, J. Urol. **56**:310-318 (Sept.) 1946.

12. Pfeiffer, G. E., and Gandin, M. M.: Massive Perirenal Lipoma with Report of a Case, J. Urol. **56**:12-27 (July) 1946.

Pfeiffer and Gandin report a case of massive perirenal lipoma on the right in a 49 year old white man. The patient had noticed a feeling of fulness in the upper part of the abdomen for six months. The mass, which weighed 26½ pounds (12 Kg.), and the right kidney were successfully removed. Eleven months after the operation the patient was in apparently excellent health and felt well.

Pyelonephritis.—Clark [13] states that the physiologic changes in the urinary tract during pregnancy are loss of muscular tone, diminution of ureteral peristalsis, ureteral dilatation and hydronephrosis. The result of these changes is stasis which predisposes the upper part of the urinary tract to infection. Preexisting disease of the urinary tract increases the possibility of complications during pregnancy.

Preventive therapy is of utmost importance. To date, the most effective bactericidal drugs are penicillin and the sulfonamide compounds. If drug therapy fails, if there is a history of preexisting renal disease or if the symptoms are unusual, cystoscopic examination, retrograde studies, differential cultures and pyelograms should be made.

Sterility of the urine must be obtained and then, if possible, maintained throughout the remainder of gestation, delivery and the puerperium.

If the infection cannot be brought under control, termination of the pregnancy must be considered.

After delivery persistent infection and residual pathologic lesions of the urinary tract must be eradicated before further pregnancies.

Tuberculosis.—Lazarus [14] reports that a combination of deep roentgen treatment with ultraviolet radiation immediately after nephrectomy for tuberculosis almost completely eliminates postoperative formation of fistulas and disintegration of the wound. Also deep roentgen therapy to the bladder is a distinct aid in alleviating vesical pain and in promoting healing of tuberculous ulcerations.

Arteriography.—Doss [15] states that renal arteriography offers a visual estimation of renal function. Its value is striking in demonstrating the condition of the kidney above a completely or partially obstructed ureter. The large hydronephrotic kidney and the kidney filled with a staghorn calculus, often considered fit only to be removed, have been found, by the aid of arteriography, to be well worth saving.

---

13. Clark, W. D.: Pyelitis of Pregnancy, California Med. **65**:21-26 (July) 1946.

14. Lazarus, J. A.: Prevention and Treatment of Delayed Wound Healing and Ulcerative Cystitis Following Surgery for Tuberculosis of the Genito-Urinary Tract, J. Urol. **55**:160-168 (Feb.) 1946.

15. Doss, A. K.: Translumbar Aortography: Its Diagnostic Value in Urology, J. Urol. **55**:594-606 (June) 1946.

Renal arteriography is of little value in the diagnosis of squamous cell epithelioma of the kidney, the papillary type solely involving the pelvis or that which infiltrates the renal parenchyma. In the extensively infiltrated kidney the examiner is likely to find diminution in the arterial supply owing to the nature of the growth. In cases of hypernephroma or true adenocarcinoma pooling out of dye throughout the neoplastic mass in reticulated fashion is usually noted. These areas represent venous and arterial sinuses so frequently seen on sectioning such tumors. The intrarenal arteries are characteristically spread out in spider-like fashion. Simple solitary cysts are readily distinguished owing to lack or apparent lessening of arterial supply traversing the cystic cavity. Smaller multiple cysts, such as those present in early polycystic disease, are rather difficult to detect.

In cases of retroperitoneal tumor it is almost invariably possible to exclude or include the kidney as the origin because of the ease with which the renal arteries may be filled with radiopaque media.

Congenital or acquired renal ectopia in its various forms may be diagnosed easily by means of arteriography. With the assistance of the aortogram this diagnostic problem can be handled much more scientifically. The attenuation of the renal pedicle, pain and relative delay in emptying of the pelvis may well lead to the correct decision with respect to nephropexy. Usually the diagnosis of renal duplication, often only suspected when the excretory urogram or retrograde pyelogram is studied, is made relatively simple by aortography. In cases in which function in a segment of a duplicated kidney is either reduced or absent defective blood supply to this part frequently is discernible. With the arterial outline at hand when heminephrectomy is indicated, it is possible to make the incision in the kidney at a relatively avascular part allowing removal of the diseased portion with minimal damage. From a vascular and therefore functional standpoint, renal parenchyma is conserved precisely and consequently, and a more applicable operation is performed. Of all investigative measures employed, aortography is doubtless the procedure of choice for discovery of the rare case of Goldblatt hypertension. No patient who has unexplained hypertension has been examined completely without translumbar arteriography. Obstruction or occlusion of one of the renal arteries can most certainly be demonstrated. The removal of a kidney presenting such arterial encroachment by no means insures cure of the hypertension, for all too often the pathologic-physiologic process has become permanent in each kidney.

With rare exception the superimposition of an aortogram on a retrograde pyeloureterogram allows determination of whether or not an aberrant vessel is responsible for the hydronephrosis. Occasionally if an aberrant artery exists its lumen is obliterated and the artery cannot be visualized.

Renal Neurosurgery for Hypertension.—Duff, Kenyon and Smith [16] have used Smithwick's method of thoracolumbar sympathectomy in 10 cases of hypertension with encouraging results. They are of the opinion that the urologic surgeon possesses fundamental advantages in this field of surgery because estimation of renal function and evaluation of the structural integrity of the kidneys are important preoperative procedures. The surgical approach is retroperitoneal and the operation should include examination of the adrenal glands and biopsy of the kidney. They also discuss denervation of the renal artery for relief of nephralgia and in conjunction with nephropexy, pyeloplasty and nephrectomy. They state that denervation minimizes postoperative pain, prevents or diminishes reflex disturbances such as acute gastric dilatation, tympanites and adynamic ileus and in most cases obviates the pain of which the patient originally complained. The prerequisites for denervation of the renal artery are a readily mobilized kidney and an accessible renal pedicle.

URETER

Anomalies.—Circumcaval ureter, also called "postcaval ureter" and "retrocaval ureter," is a congenital anomaly in which the ureter passes behind the inferior vena cava. Goyanna, Cook and Counseller [17] present a case of a man, 33 years old, who had suffered for three years with recurrent attacks of pain in the right side of the back, chills, fever, urinary frequency and dysuria, in which the diagnosis of right circumcaval ureter was made preoperatively by means of retrograde pyelography. At operation the right ureter was divided at the point of angulation about 3 inches (7.6 cm.) below the ureteropelvic junction and about 1½ inches (3.8 cm.) was excised. A v-shaped portion was excised from the proximal portion of the ureter to decrease its diameter, and an end to end anastomosis of the severed portions of the ureter was made over a splinting catheter. A nephrostomy tube was brought out through the lower calix of the kidney. On the thirtieth postoperative day the ureteral splint was withdrawn, and on the thirty-ninth day the nephrostomy tube was removed. One year after operation the patient was feeling well and was free from symptoms. Goyanna, Cook and Counseller think that this anomaly may not be so rare as was formerly supposed, as 8 cases have been encountered since 1940 (5 were of clinical significance) while only 26 cases were reported from 1888 to 1940.

16. Duff, J.; Kenyon, H. R., and Smith, K. F.: Malignant Hypertension: Neurosurgery of the Kidney, J. Urol. **55**:153-158 (Feb.) 1946.

17. Goyanna, R.; Cook, E. N., and Counseller, V. S.: Circumcaval Ureter: Report of Case in Which Diagnosis Was Made Preoperatively, Proc. Staff Meet., Mayo Clin. **21**:356-360 (Sept. 4) 1946.

Riba, Schmidlapp and Bosworth [18] report a case of ectopic ureter draining into the seminal vesicle and discuss the literature. In 23 of the 32 cases in which necropsy was performed the patients were between the ages of 6 and 73 years at the time of death; the average age was 48.3 years. This anomaly was present on the left side in 21 cases and on the right in 11. In 26 cases the ectopic ureter was single, and in 6 there was duplication. In 14 cases the corresponding kidney was rudimentary, and it was absent in 10. A double kidney was noted in 3 cases; fibrosis of the kidney, in 2, and cystic degeneration, in 2. In only 1 case was the kidney found to be normal at necropsy.

The distribution of these aberrant ureteral openings is of interest. The ureters in 22 cases drained into the seminal vesicals (18 into the left, 4 into the right) and in 10 cases, into the vas deferens or ejaculatory duct (7 into the right, 3 into the left).

The opening of an ectopic ureter into the seminal tract has been reported clinically four times. In two of these reports the ectopic ureter was a duplicated one and in two the ureter was single. One single and one duplicated ectopic ureter opened into the right seminal vesicle, while the remaining two opened into the left seminal vesicle. In all 4 cases, pyuria (intermittent in 2 and constant in 2) was the outstanding finding. In addition, 3 patients had pain, frequency, terminal hematuria and fever. One patient remained asymptomatic.

The case of a young man with a double left ureter is presented. The ectopic ureter drained into the left seminal vesicle. The source of the pyuria remained obscure for several months. The cloudy second glass of urine suggested disease of the seminal vesicle. Further roentgenologic examination after catheterization of the ejaculatory ducts simplified diagnosis. Complete excision of this anomalous left ureteroseminal vesicle cleared the urine permanently. Chemotherapy, including administration of penicillin, failed to remove the chronic infection.

Honke [19] presents a case of ectopic ureter in a married woman, 30 years old. Two ureteral openings in the right lateral vaginal wall approximately 2¼ inches (5.72 cm.) and 3 inches (7.6 cm.), respectively, from the orifice were the outlets of a common ureter leading from a small rudimentary renal pelvis located in the upper pole of the right kidney. This ureter apparently bifurcated about 5 cm. from its vaginal termination. The condition was cured by heminephrectomy on the right kidney.

Ureterocele.—Ortmayer, Koester and Stetler [20] present a case of prolapse of a ureterocele through the urethra in a woman, 64 years

18. Riba, L. W.; Schmidlapp, C. J., and Bosworth, N. L.: Ectopic Ureter Draining into the Seminal Vesicle, J. Urol. **56**:332-338 (Sept.) 1946.

19. Honke, E. N.: Ectopic Ureter, J. Urol. **55**:460-463 (May) 1946.

20. Ortmayer, M.; Koester, L., and Stetler, P. M.: Prolapsus of a Ureterocele Through the Urethra, J. Urol. **55**:515-519 (May) 1946.

old. She complained of "something coming out of the vagina" on straining for urination or defecation. The mass receded spontaneously when she was asleep or when it was pushed back. At cystoscopy a large ureterocele, 2 to 3 cm. in diameter, was found and it was determined that intermittent prolapse through the urethra occurred. The ureterocele was electrocoagulated, and ten months later cystoscopic examination revealed a large cuff of tissue, the proximal remnant of the ureterocele, surrounding the right ureter. The patient was entirely free of symptoms.

Stones.—Garvey and Gomberg [21] compare the advantages and disadvantages of vaginal and abdominal ureterolithotomy. Disadvantages of the abdominal approach are: 1. The operation is difficult in obese patients and patients who have had previous operations on the lower part of the abdomen. 2. The ureter may be difficult to locate deep in the pelvis and may not be easily accessible. 3. The danger of shock is greater. 4. The abdominal incision presents the danger of postoperative hernia. 5. Convalescence is prolonged because drainage is poor and a postoperative febrile course with formation of abscess and fistula may follow. 6. The technic of the operation is difficult for the surgeon.

The comparative advantages of the vaginal approach are: 1. Obesity or previous abdominal scars provide no hindrance. 2. The ureter is located easily. 3. Little shock is associated with the procedure and abdominal contents are not manipulated. Local anesthesia may be used to minimize the danger of shock further. 4. An external incision is not made and there is no danger of postoperative hernia. 5. Convalescence is smooth, the hospital stay is short and drainage is dependent. 6. The operation is easier, less stripping of the ureter is necessary and impairment of the blood supply is minimal. Consequently, the danger of slough and formation of fistula is less.

The advantages of the abdominal approach are: 1. An incision can be made in the ureter above the point of impaction and the stone drawn up to the site of the incision for removal; if the stone slips away it can be moved up or down the ureter. 2. The incision can be enlarged to provide better exposure.

The disadvantages of the vaginal approach are: 1. If the stone slips up the ureter or is higher than anticipated, it cannot be drawn down. 2. The exposure is limited and the operation is difficult in nulliparas.

The authors state that the anatomy of the lower portion of the ureter makes it especially accessible from the vagina. In women the terminal portion of the ureter lies on the medial side of the uterine artery on the pelvic wall and turns forward and medianward below the posterior layer

21. Garvey, F. K., and Gomberg, D.: Vaginal Ureterolithotomy, J. Urol. **56**: 49-56 (July) 1946.

of the ligamentum latum uteri to the base of the urinary bladder; in so doing it runs through the parametrium, somewhat lateral from the cervix uteri. It then comes into direct contact with the anterior and lateral walls of the vagina, being crossed in front by the uterine artery at the level of the orificium internum ureteris. The prime prerequisites for vaginal ureterolithotomy are that the stone be palpable through the vaginal wall and that the patient be parous. It is impossible to expose the ureter for more than 2½ inches (6.4 cm.) above the ureterovesical junction.

The surgical procedure is as follows: The cervix is grasped with a tenaculum and retracted laterally in the opposite direction from the involved ureter. An incision about 1 inch (2.5 cm.) long is made as far laterally as possible, through the vaginal wall at the level of the cervix or directly over the stone if possible. A suture to be used for retraction may be placed through the upper edge of the incision, or suitable retractors may be used. The loose tissues are separated carefully with a curved hemostat until the ureter is seen, and the ureter is grasped above the stone with an Allis forceps, a longitudinal incision is made over the stone, and the stone is removed. After the stone is removed a bougie is passed up the ureter from the incision and also down through the intramural portion of the ureter to dilate it and prevent obstruction as a result of postoperative edema. The ureter is closed with one to three catgut sutures placed in the adventitia, and a small, soft rubber drain is inserted in the wound. Care must be taken to avoid placing it against the ureter. The incision in the vaginal wall is then closed. The drain is removed in twenty-four hours and the patient is allowed out of bed on the same day.

Garvey and Gomberg have carried out this procedure in 13 cases. The operation in 12 was successful and in 1 it failed. They state that the danger of ureterovaginal fistula is slight and that if no obstruction is present below the site of incision no fistula will form.

Trauma.—Howard [22] reports 8 cases of proved instrumental perforation of the ureter. The condition is probably more common than the small number of proved cases reported might indicate.

When the rent in the ureter is small and the ureter is not obstructed below it, there is ordinarily no untoward reaction and the patient readily recovers without surgical treatment. A serious condition may result if complicating urologic conditions occur or if the opening in the ureter is large enough to allow extravasation to occur and to continue in large amounts. Perforations by large instruments are more likely to be serious than those produced by small ones.

In itself, instrumental perforation of the ureter calls for observation rather than immediate surgical treatment. The time for drainage is determined by surgical judgment in the individual case. Most patients who recover without surgical intervention are either well or nearly well twenty-four hours after the injury.

22. Howard, F. S.: Instrumental Perforation of the Ureter, J. Urol. **56**:319-331 (Sept.) 1946.

PROSTATE

Hypertrophy.—McCrea [23] reports a case of massive enlargement of the prostate in which the patient was a white man, 88 years old, who for the previous twenty-five years had had repeated episodes of acute urinary retention every six to twelve months. Each time retention was relieved by a single catheterization. The patient did not suffer additional symptoms sufficient to cause him to consider surgical relief. At necropsy the prostate and bladder were removed; they weighed 1,300 Gm., substantiating the statement that, clinically, the size of the hypertrophied prostate rarely bears any relationship to the degree of symptoms produced.

Carcinoma.—Wattenberg [24] reports a case of toxic hepatitis resulting from the giving of large doses of diethylstilbestrol for carcinoma of the prostate gland.

Other effects of diethylstilbestrol which occur during the treatment of carcinoma of the prostate gland are changes in the breast, dependent edema, reactions in the urethra, seminal colliculus and testes, and changes in the prostatic carcinoma. The presence of these changes is no index of the benefit which the patient receives from this treatment of the cancer of the prostate gland.

The change in the breast is extensive proliferation of the ductal epithelium. The ducts become elongated and budding is present. Edema of all the tissues is considerable and the connective tissue and vascularity are increased. Deposition of fat also can occur.

Often edema occurs while the patient is being treated with diethylstilbestrol. This edema usually occurs in the lower extremities and is due to a decreased renal excretion of sodium and chloride, which in turn causes water to be retained in the tissues. Consequently the volume of urine is reduced and thereby dependent edema is produced.

The change which takes place in the urethra is squamous metaplasia, and considerable metaplasia and stratification of the epithelium of the seminal colliculus occur after therapy with diethylstilbestrol.

After treatment with diethylstilbestrol or any other estrogenic substance the testes show a thickened basement membrane of the seminiferous tubules with fibrous tissue. Often a rapid and advanced degree of atrophy of the testes can take place.

In the prostatic cancer before treatment with diethylstilbestrol most of its cells are arranged in acini. The cytoplasm is foamy and the nuclei, located in the central portion of the cell, are large and round and

23. McCrea, L. E.: Massive Enlargement of the Prostate, Am. J. Surg. **71:** 284-286 (Feb.) 1946.

24. Wattenberg, C. A.: Liver Changes and Other Effects of Diethylstilbestrol During Treatment of the Prostate Gland Cancer, J. Urol. **55:**631-640 (June) 1946.

contain rounded vacuoles. After the patient has taken diethylstilbestrol, the cytoplasm regresses, the nuclei become smaller, irregular and pyknotic, and no definite arrangement of cells is noted. In some portions there are no nuclei and only cell remnants are seen.

Lazarus [25] states that discrepancies between clinical and pathologic data in certain carcinomas of the prostate gland may be consequent of (*a*) failure of the pathologist to cut sections from an adequate number of tissue blocks and (*b*) failure of the pathologist to receive tissue from the part of the prostate harboring the malignant lesion.

Failure to remove the so-called false capsule of the gland in prostatectomy is the principal cause of failure to remove the carcinomatous portion. This may occur particularly in suprapubic or incomplete transurethral prostatectomy. The lesion is sometimes chiefly, if not entirely, confined to this portion of the gland. This holds true of prostates with large adenomas and with small malignant nodules.

Therefore, when a urologist, after thorough examination of his patient, surmises that he is confronted with carcinoma of the prostate gland, he should proceed with the accepted treatment of this disease, despite the contrary opinion of the pathologist. The surgeon will thereby reduce the patient's suffering and possibly prolong his life.

TESTIS

Tumors.—Brewer [26] presents 2 cases of tumor of the testis. One was a teratoma and the other a seminoma. However, in each case the metastatic lesion was a choriocarcinoma. When each patient was examined first biologic tests for chorionic gonadotropin in the urine gave positive results. The writer concluded that chorionic tissue was present in the teratoma and seminoma, respectively, even though no chorionic tissue was identified in the sections examined microscopically. The chorionic tissues may not be demonstrated in the primary tumor because (1) it may be but a small part of the growth, (2) the entire tumor is not examined microscopically or (3) it is impossible microscopically to distinguish chorionic tissue from the multiple and varied tissues of a testicular tumor. In instances of teratoma, seminoma and such tumors, when the results of the test for chorionic gonadotropin are negative, choriocarcinoma does not coexist. If chorionic gonadotropin is present in the urine of a patient with a testicular tumor, it indicates the presence of choriocarcinoma even though chorionic tissue is not identified microscopically in the primary tumor.

---

25. Lazarus, J. A.: Questionable Cancer of the Prostate Gland: Clinical Versus Routine Pathologic Evidence, J. Urol. **55**:618-625 (June) 1946.

26. Brewer, J. I.: Chorionic Gonadotropin in the Diagnosis of Testicular Tumors, Arch. Path. **41**:580-591 (June) 1946.

Mathé[27] reports a case of lymphosarcoma of the testis in which the patient was a white man, aged 63 years. No evidence of metastasis was found at the time of orchiectomy. The tumor measured 6.5 cm. in diameter. Three months later the tumor recurred at the site of the severed cord and multiple small nodular cutaneous metastatic lesions were found throughout the entire body. Mathé states that lymphosarcoma of the testis is extremely rare, usually occurs in the younger age group, is highly malignant and rapidly fatal. Treatment consists of (1) orchiectomy with radical removal or irradiation of the regional lymph areas or (2) irradiation alone. Surgical removal is the most desirable method when no evidence of metastasis is discernible. It is important to expose the cord at the external ring and to clamp and ligate the vascular pedicle early to prevent dissemination of malignant cells. Severing the vas deferens as high as possible is a further valuable precautionary measure against extension. The wound is bathed in alcohol to destroy any tumor cells that might have escaped.

Scheetz and Leddy[28] state that teratoma is a tridermic tumor in which one or more of the components may undergo malignant degeneration and estimate that about 1 of every 10,000 males admitted to a hospital will have a malignant teratoma of the testis. They report therapeutic results in 54 cases of malignant teratoma observed at the Mayo Clinic and conclude that roentgen therapy does not seem to have any beneficial effect in cases of malignant teratoma, which is extremely resistant to roentgen rays. The only manner in which a cure can be obtained is by orchiectomy before metastasis has occurred. This can be attained in less than a third of cases. After metastasis has occurred death usually follows within eighteen months.

Auerbach, Brines and Yaguda[29] report a study of cases of neoplasm of the testis. In a United States naval hospital designated as a cancer center for naval personnel, in which one hundred and fifty beds are allotted to the tumor service, necropsy was performed in 26 cases of malignant tumor of the testis in a period of three years, 22 of these being encountered in the last two years. These 26 cases represented 20 per cent of all cases of malignant disease in which necropsy was performed at this hospital during this period.

Seventy-three per cent of all patients were in the third decade.

Treatment in 23 cases consisted of simple orchiectomy and high voltage roentgen therapy in the regions of metastasis.

---

27. Mathé, C. P.: Lymphosarcoma of the Testicle: Report of a Case, J. Urol. **55**:530-541 (May) 1946.

28. Scheetz, R. J., and Leddy, E. T.: Roentgen Therapy for Malignant Teratoma of the Testis, Am. J. Roentgenol. **55**:754-764 (June) 1946.

29. Auerbach, O.; Brines, O. A., and Yaguda, A.: Neoplasms of the Testis, J. Urol. **56**:368-374 (Sept.) 1946.

The average duration of life after the institution of treatment was eleven months. No patient lived more than twenty-two months after the diagnosis was made.

Trauma did not appear to play an important etiologic role in this series of cases.

The distribution of metastatic lesions followed a uniform pattern in nearly all cases, the four principal secondary sites being, in order of prevalence, retroperitoneal lymph nodes, lungs, mediastinal lymph nodes and liver.

Varicocele.—Beneventi [30] states that varicocele is a varicosity of the pampiniform plexus and should be considered as detrimental a condition for the testis as varicose veins are for the lower limbs. He reports the surgical treatment in 28 cases. The object of the treatment was prevention of venous backflow into the pampiniform plexus by ligation of the internal spermatic vein in the inguinal canal at the internal ring. A 3 inch (7.6 cm.) inguinal incision is made slightly above and parallel to Poupart's ligament. The skin, subcutaneous tissue and Scarpa's fascia are incised and retracted from the underlying external oblique aponeurosis. The external ring and the cord emerging from it are identified. An incision is then made in the aponeurosis along the course of its fibers beginning at a point about 1 cm. lateral to the ring, thereby leaving the arcuate fibers of the external ring intact. The cut edges of the external oblique muscle are retracted and the inguinal canal and its contents are exposed. The cremasteric muscle is then incised and the elements of the cord are separated. In order to preclude injury to the vas deferens and the internal spermatic artery, these structures are first identified and retracted out of the field of operation. The enlarged and distended internal spermatic vein or veins are easily identified and bluntly separated from the surrounding structures. Careful search is then made for a hernial sac in the region of the internal ring, and if one is found high ligation and excision are then carried out. If some slack is found in the transversalis fascia, this is taken up with two or three sutures. The transversalis fascia and the conjoined tendon are then sutured to the shelving edge of Poupart's ligament. Kocher clamps are then placed on the offending veins and a 1 inch (2.5 cm.) segment of vein is excised. The stumps are ligated and the ends are bound together. A needle is then threaded with the long ends of the ligature and the obliterated veins are sutured to the under surface of the internal oblique muscle. The elements of the spermatic cord are then reposited on the newly constructed floor of the inguinal canal, and the cut edges of the external oblique aponeurosis are either approximated or imbricated. If hernial repair has been necessary the patients remain in bed for six days; otherwise they are up on the second or third postoperative day.

30. Beneventi, F. A.: Varicocele, Am. J. Surg. **71**:783-787 (June) 1946.

Beneventi makes the following observations: 1. The internal spermatic vein was often doubled or bifurcated. 2. The internal spermatic artery (a branch of the abdominal aorta) was closely associated with the veins in the cord and great care must be exercised to avoid injuring it. 3. The external spermatic artery (cremasteric), a branch of the inferior epigastric artery, is distributed in the elements of the sheath of the spermatic cord. It is the chief source of bleeding when the cord is manipulated. 4. A small indirect incomplete hernial sac was found in 8 cases. Seven of the 8 patients were between the ages of 28 and 31 years. All had large varicoceles which had been present for from five to twelve years 5. The external ring was allowed to remain intact unless it was unduly relaxed.

The postoperative course is short, and testicular tenderness may be present temporarily. Beneventi concludes that a satisfactory operation without disturbing complications can be assured in almost every case of varicocele treated by the method which he describes.

TORSION OF THE SPERMATIC CORD

Riba and Schmidlapp [31] discuss torsion of the spermatic cord and present 5 cases. The patients were young soldiers. The authors state that if a history of acute excruciating pain in the testis is obtained from a patient who does not have infection of the urinary tract the physician should suspect that acute torsion of the cord has occurred. The pain may follow any type of muscular effort or exertion and is usually most severe during the first twenty-four hours, and after forty-eight to seventy-two hours it will spontaneously begin to subside. Riba and Schmidlapp state that if a history of recurrent pain in one or both testes is obtained and the patient is less than 20 years old the presence of chronic recurrent torsion of the cord should be suspected, especially when infection is absent. In acute cases swelling, edema and tenderness of the involved testis are noted. Elevation of the testis may aggravate the pain if torsion has occurred (Prehn's sign), whereas it usually tends to relieve the pain of acute epididymitis. The contents of the involved scrotum may be fixed to the adjacent coverings (Dillon's sign). In cases of neglected torsion of the spermatic cord the outstanding findings are the rubbery, firm, smooth testis which is elevated and retracted against the external inguinal ring. In late cases the testis becomes smaller and asymptomatic and finally it atrophies completely. It is extremely important to make a diagnosis early if the testis is to be saved. Surgical detorsion may be possible and should be followed by orchiopexy to preclude subsequent attacks In acute torsion if operation is performed immediately or within eight hours the organ will usually remain viable. Riba and Schmidlapp are of the

31. Riba, L. W., and Schmidlapp, C. J.: Torsion of the Spermatic Cord, Surg., Gynec. & Obst. **83**:163-170 (Aug.) 1946.

opinion that many testes could be saved if exploration were carried out in a few cases of acute epididymitis in which a mistaken diagnosis of torsion had been made rather than treatment of the majority of acute torsions conservatively as epididymitis.

EPIDIDYMIS

Tumors.—Sworn, Marshall and Edwards [32] report 2 cases of tumor of the epididymis. On microscopic examination each tumor showed a fibrous capsule containing plain muscle fibers. Within the capsule the tissue consisted of tubules lined by a single layer of flattened and cubical cells with rounded and vesicular nuclei. No mitotic figures were observed. The tumors measured 2 by 2.2 cm. and 1.7 by 1.25 cm., respectively, and were concluded to be of the benign "adenomatous" type.

PENIS

Tumors.—Melicow and Ganem [33] state that penile neoplasms are found almost exclusively in uncircumcized patients. Although the neoplasms should be discovered early because the penis is one of the most frequently handled parts of the body they are often well advanced and frequently have metastasized by the time the diagnosis is made. The delay in establishing a diagnosis is apparently due to the fact that the tumor grows insidiously within an enclosed preputial cavity which has already given the patient prolonged trouble with infection, edema and retention of secretions. Penile cancer represents about 2 per cent of all malignant lesions in the male. It is almost unknown among Jewish men. The writers are of the opinion that the chronic irritation in cases of phimosis and chronic balanoposthitis probably gives rise to development of some carcinogenic agent or agents, possibly altered smegma or a virus or both. The majority of penile cancers develop on the glans at the corona or sulcus, and are usually squamous cell epitheliomas. Precancerous lesions which occur are leukoplakia, erythroplasia of Queyrat, Paget's disease and Bowen's disease.

The majority of penile neoplasms appear either as a papillary excrescence or as an induration which is usually ulcerated and proves refractory to local treatment. Early lesions are painless; however, later, when ulceration and secondary infection develop, there may be pain and bleeding. The inguinal lymph nodes tend to become enlarged as the result of inflammatory or neoplastic changes secondary to the penile lesion. Lymphatic drainage occurs though a deep and superficial system. The lymph nodes of the skin and subcutaneous tissue drain

32. Sworn, B. R.; Marshall, F. W., and Edwards, J. L.: Solid Tumors of the Epididymis, Brit. J. Surg. **33**:375-377 (April) 1946.

33. Melicow, M. M., and Ganem, E. J.: Cancerous and Precancerous Lesions of the Penis: A Clinical and Pathological Study Based on Twenty-Three Cases, J. Urol. **55**:486-514 (May) 1946.

into the superficial inguinal nodes. Those of the glans penis and urethra drain into the deep inguinal nodes and external iliac nodes of the pelvis. Some lymphatics may drain directly into the external iliac lymph nodes without joining the inguinal nodes. Microscopic evidence of metastasis to inguinal nodes may be found even though the glands cannot be palpated. Metastasis by way of the venous system may occur. Distant metastatic lesions may be found in the bony pelvis, prostate, lungs, spleen, mediastinal glands, skull and brain.

Regarding treatment, there should be no undue delay between diagnostic biopsy and operation. Type of treatment may vary from simple circumcision to radical amputation with dissection of the lymph nodes. Routine dissection of the inguinal lymph nodes is probably the procedure of choice in all cases, however. Factors to be considered in the choice of treatment are: (1) the patient's age; (2) the size of the lesion; (3) the nature of the lesion; that is, whether papillary or ulcerative; (4) involvement of the superficial lymphatic channels of the penis; (5) extension through Buck's fascia into the corpora cavernosa of the penis; (6) the presence or absence of palpable inguinal lymph nodes; (7) the degree of superimposed infection, and (8) coincident presence of other disease and general condition of the patient. Opinion regarding the use of postoperative irradiation differs, and Melicow and Ganem have observed no lasting benefit.

STERILITY

Tompkins [34] states that complete study of male sterility must include an accurate sperm count. The most acceptable specimen is one which is obtained by means of masturbation and is collected in a clean glass container. Specimens obtained in a condom are unsatisfactory for two reasons: chemicals in the rubber or in the talc devitalize some of the sperms and an indeterminate number of sperms adhere to the penis. Withdrawal specimens are also unreliable. Fractional counts show that as many as 75 per cent of the total number of sperms may be contained in the first third of the semen ejaculated. If any of the specimen is lost before withdrawal, as frequently happens, it will be the first portion which contains most of the sperms. Therefore, all who have studied male infertility agree on the necessity of masturbation in obtaining specimens for accurate counts.

In making the sperm count at least two specimens must be studied before formulation of an opinion is justified. A differential count and a test of the duration of motility must be included. Normal semen contains 100,000,000 or more sperms per cubic centimeter, and 80 per cent of the spermatozoa are morphologically normal. A count of

34. Tompkins, P.: Medical Progress: Current Methods for the Study and Treatment of Sterility, California Med. **65**:76-80 (Aug.) 1946.

less than 60,000,000 indicates relative infertility. The degree of fertility is roughly directly proportional to the count. If complete absence of sperms in the semen is found, testicular biopsy should be carried out to distinguish between failure of spermatogenesis and vaso-epididymal occlusion.

URETHRA

Anatomy.—Deter, Caldwell and Folsom [35] state that knowledge of the embryology of the female urethra is meager.

Krenchevsky's research indicates a definite homology between the prostatic urethra of the male and the posterior portion of the urethra of the female.

Periurethral glands were found to be present in 92 per cent of 100 urethras studied. A majority of glands were found to be lateral and posterior to the urethra, and the distribution was approximately the same as that found in the male prostatic tissue. The closer to the bladder the sections were taken, the greater the number of glands found.

The role played by periurethral glands in harboring infection and distributing it to the upper part of the urinary tract is again emphasized.

The pathologic findings are tabulated, and it is concluded that the number of glands in the posterior portion of the urethra, beyond a certain point, is not a factor in harboring infection. A certain degree of glandular development seems to have a definite relationship to the development of posterior urethritis in females.

Urinary Extravasation.—Howland [36] reports a study of 60 cases of urinary extravasation. In previous studies, the mortality rate has ranged up to 50 per cent and beyond, except for one small series in which Ockerblad and Carlson reported 1 death in 15 cases encountered in a period of ten years.

Howland considers that urethral abscess and urinary extravasation are two stages of the same process. If urine is extravasated below Buck's fascia periurethral abscess is present; if urine is extravasated beyond this barrier the condition is called "urinary extravasation."

Howland's 31 cases of urinary extravasation and 29 cases of periurethral abscess were encountered at Grady Hospital during the last two years. The high incidence of gonorrhea in the Negro, together with the neglect and improper treatment of the original urethritis, makes the incidence of urinary extravasation higher at that hospital than at other institutions. All except 2 of the patients were Negroes, and the majority were in the age group of 30 to 50 years. The range was from 18 to 69 years.

---

35. Deter, R. L.; Caldwell, G. T., and Folsom, A. I.: A Clinical and Pathological Study of the Posterior Female Urethra, J. Urol. **55**:651-662 (June) 1946.

36. Howland, W. S.: Urinary Extravasation: A Study of Sixty Cases, J. Urol. **56**:387-391 (Sept.) 1946.

The etiologic condition was urethral stricture in 49 cases, while in 2 it was undetermined. In the remainder the various causative factors included urethral stone, gunshot wounds, external trauma, use of sounds and catheterization.

The diagnosis of extravasation is relatively easy if careful examination of the genitalia and perineum is made. The onset of periurethral abscess is gradual. The abscess begins as a swelling in the perineum which is tender, nonfluctuant and well localized. Occasionally, pressure on the abscess will extrude pus from the urethra.

In urinary extravasation pronounced swelling of the scrotum and the penis usually is present, and sometimes the anterior abdominal wall is swollen. Little or no tenderness is noted, but the skin pits easily. Discharging sinuses may be present if the extravasation has continued for a long time The patient always looks much sicker than one who has periurethral abscess, and jaundice may be present. Contrary to previous reports, knowledge of the patient's temperature was of little value in differentiating the two conditions. In Howland's series, the temperature curves were about the same in the two conditions. Temperatures ranged up to 104 F. These conditions are frequently mistaken for perianal abscess, epididymitis and obstructive phimosis. Also many cases of massive edema due to congestive heart failure are called extravasations.

The duration of the condition varied; the average was from one to five days. In some cases it was as long as two weeks. The duration had little relation to mortality, although when the disease was of long duration recovery took more time.

The majority of the organisms in these conditions are sensitive to sulfonamide compounds and penicillin. The decided drop in mortality rate which Howland notes is probably based on that fact. In 19 cases staphylococci were found; in 19, streptococci and in 4, Escherichia coli.

The method of treatment now used at Grady Hospital consists of immediate drainage of the infected portions and diversion of the urinary stream. This is accomplished by means of suprapubic cystostomy and multiple incisions and drainage. Perineal urethrotomy was not found to be feasible because of the associated stricture which occurred in almost all of Howland's cases. In several, the entire anterior abdominal wall was incised down to the external oblique aponeurosis. The incisions were connected by Penrose drains. In periurethral abscess, pus usually is not found until Buck's fascia has been opened. The abscess cavity is then packed with iodoform gauze packs. If the patient has a high temperature or if symptoms of toxicity occur, administration of the sulfonamide compounds is started immediately and a transfusion of whole blood or plasma is given. When the urethra has been dilated and allows passage of a 24 F. catheter, the tube is removed and the suprapubic sinus is allowed to close. The patient

returns weekly for passage of sounds for about three months, and after that at least four times a year.

In Howland's series, suprapubic cystostomy was performed in 51 cases. In 6 cases treatment consisted of perineal urethrotomy or dilatation of the urethra and catheterization. But he observed that the conditions tend to recur and it is necessary to perform suprapubic cystostomy at a later date.

The length of the hospital stay was considerably shorter than has been reported. More than half (35) of the patients were dismissed in the first two weeks after operation. Five of the 65 patients died.

SEMINAL VESICULITIS

Seabaugh [37] reports 2 cases of acute congestion of the seminal vesicles which exhibited symptoms of acute disease of the lower part of the abdomen. Both patients were young men in the navy. While in the United States their sexual activity had been extensive. When they were transferred to a small tropical island base they had neither intercourse nor nocturnal emission from the time of their arrival to the date of their admission to the hospital, a period of about three months. One patient had pain in the right lower quadrant of the abdomen and was operated on for appendicitis. However, the appendix was normal and the pain persisted postoperatively. Seven days after operation rectal examination revealed that both seminal vesicles were enlarged markedly and that the right one was tender. By means of massage 10 cc. of gelatinous secretion containing pus, grade 2 plus, was removed. The pain was relieved and did not return following the massage. The second patient had pain in the left lower abdominal quadrant, and examination revealed bilateral enlargement of the seminal vesicles. The left one was especially tender. Six cubic centimeters of gelatinous secretion containing pus, grade 3 plus, was removed by means of massage. The abdominal pain disappeared immediately after the first massage.

PYELITIS, URETERITIS AND CYSTITIS CYSTICA

Kopp [38] states that the chief complaints of patients who have ureteritis and cystitis cystica are of pain in the lumbar region of long duration, frequently of chills and fever and often of nausea and vomiting. On physical examination costovertebral tenderness of the involved side is usually present. The condition usually is associated with chronic infection of the urinary tract, and stones are frequently present.

37. Seabaugh, D. R.: Seminal Vesiculitis (Congestive) Simulating Acute Abdominal Disease, J. Urol. **55**:173-178 (Feb.) 1946.

38. Kopp, J. H.: Pyelitis, Ureteritis and Cystitis Cystica, J. Urol. **56**:28-34 (July) 1946.

On cystoscopic examination the trigone is seen to be covered with many small translucent cysts and the ureteral orifice of the involved side or sides is usually edematous and reddened. The uretheral catheter meets with obstruction which is temporary because the cysts are ruptured as the catheter is passed. This rupturing may cause the passage of some blood around the catheter, which is significant of ureteritis cystica. Relief of pain after passage of the catheter is also diagnostic. The appearance of dye may be delayed, but renal function usually is not impaired. The characteristic appearance of the lesion on roentgenologic examination is diagnostic. The filling defects in the ureter, usually in the upper two thirds, give the ureter a bubbly or frothy appearance. These defects easily can be mistaken for nonopaque calculi or air bubbles. Evidence of any coexistent renal disease will also be seen at this time.

Treatment consists of dilating the ureter, thereby rupturing the cysts, and instillation of silver nitrate to destroy the traumatized cysts by its astringent action. Successful treatment of the lesion with sulfathiazole has been reported.

Kopp reports 3 cases of ureteritis cystica. Two of the patients were men, aged 60 and 23 years, respectively, and 1 was a woman, 59 years old. The condition of the younger man was treated successfully by means of ureteral dilations and silver nitrate.

Arduino [39] reports a case of pyelitis and cystitis cystica in a white man, 55 years old. On cystoscopic examination marked cystic changes over the trigone were observed and retrograde pyelograms revealed that the calix of each kidney was somewhat dilated and had a mottled appearance. These abnormalities were considered to be due to small cystlike structures in the calices. Results of guinea pig inoculation were negative for tuberculosis. Alcaligenes faecalis was cultured from urine from the left kidney. The patient's symptoms of nocturia, frequency, urgency and hesitancy ceased when sulfathiazole was administered, pyuria was decreased and renal function was improved notably. Arduino reports that the cystic disease in this case was due to a chronic inflammatory process and that this condition may be present in cases of carcinoma, calculi associated with infection, ureteral obstruction, schistosomiasis and possibly with excretion of toxic substances through the urinary tract.

ANTIBACTERIAL AGENTS

Sulfonamide Drugs.—Flippin and his associates [40] report the use of both sulfadiazine and sulfamerazine in 54 cases. Crystals were found

39. Arduino, L. J.: A Case of Pyelitis and Cystitis Cystica, J. Urol. **55**:149-152 (Feb.) 1946.

40. Flippin, H. F., and Reinhold, J. G.: An Evaluation of Sulfonamide Mixtures and Various Adjuvants for Control of Sulfonamide Crystalluria, Ann. Int. Med. **25**:433-442 (Sept.) 1946.

in 6 per cent of the urine specimens when the mixture was administered at the rate of 4 to 6 Gm.daily, equal parts of each drug being used. The patients received no alkali or other adjuvant. This incidence of crystals was the same as that found in a group of patients who received a parallel dose of either sulfadiazine or sulfamerazine alone and 12 Gm. of sodium bicarbonate daily. When only 6 Gm. of sodium bicarbonate was used the incidence of crystalluria was increased to almost four times that when sulfadiazine or sulfamerazine was administered alone.

Because of the inadequacy of alkalinization and water diuresis in the prevention of the formation of crystalline deposits of sulfonamide drugs in the kidneys, Lehr [41] experimented with the use of sulfonamide mixtures instead of single compounds as a method of combating this hazard. He concludes that the use of sulfonamide mixtures should add considerably to the protective action of alkalinization and forcing of fluids. It was found that two or more sulfonamide compounds, if present simultaneously in water or urine, did not influence each other with regard to their particular solubilities. A saturated aqueous solution or urinary solution of sulfathiazole could still be fully saturated with sulfadiazine and sulfamerazine. The antibacterial activity of a combination of sulfathiazole and sulfadiazine (in equal amounts) corresponds largely to the total concentration of free sulfonamide compounds. In many instances it was found that the mixture was even more effective than the the same total concentration of either drug alone.

Therapeutic studies with a mixture containing equal parts of sulfathiazole and sulfadiazine were carried out under carefully controlled conditions in 70 unselected cases of acute bacterial infections. Special consideration was given to daily follow-up studies of the concentration of the sulfonamide compounds in blood and urine, to the frequency of occurrence of sulfonamide crystals in the urine and its relationship to the urinary p_H and to any signs or symptoms of renal complications. Treatment consisted in the oral administration of the combination of sulfathiazole and sulfadiazine; 4 Gm. initially (2 Gm. of sulfathiazole plus 2 Gm. of sulfadiazine) and then 1 Gm. of the combination every four hours day and night, and decreased to 1 Gm. every six hours when defervescence and other clinical signs indicated significant improvement. A minimal fluid intake of 3,000 cc. in twenty-four hours was maintained. In almost all cases in this series the therapeutic response was highly satisfactory. Defervescence and general clinical improvement seemed to occur with greater speed than when either of the drugs were administered separately. Crystalluria was encountered in but few instances despite the almost constant presence of high concentration of the sul-

41. Lehr, D.: The Prevention of Renal Complications by the Therapeutic Employment of Sulfonamide Mixtures: I. Sulfathiazole-Sulfadiazine Combination, J. Urol. **55**:548-566 (May) 1946.

fonamide mixture in acid urine. In none of the cases was there any evidence of renal irritation, such as hematuria, casts or oliguria.

This series, although too small for a conclusive evaluation, was conspicuous because of the unusual speed in the therapeutic response in many instances and also because of the almost complete absence of toxic effects. Persistent and massive crystalluria observed so frequently in treatment with sulfadiazine and especially with sulfathiazole was not encountered despite the intentional omission of adjuvant alkali therapy. It is common knowledge that the incidence of crystalluria is much higher than the incidence of discernible renal irritation. Lehr is of the opinion that it is primarily the mechanical factor of intratubular deposition of poorly soluble crystals rather than a primary chemical nephrotoxic action which accounts for most renal complications of sulfonamide therapy.

Penicillin.—Mathé [42] reports on the use of penicillin as an adjunct to genitourinary surgery, stating that it is often a lifesaving measure in the aged patient who has disease of the prostate and is sensitive to the sulfonamide compounds. The importance of penicillin is enhanced by its bacteriolytic effect on staphylococci which have proved refractory to sulfonamide therapy. In 8 of the 11 cases reported the surgical risk was poor because overwhelming mixed urinary infection was present. Penicillin therapy, instituted prophylactically in 6 and therapeutically in 5, controlled infection and hastened the patient's return to health in all. Mathé states that in this group of cases penicillin has surpassed any other chemotherapeutic agent formerly used. Acute infections with organisms susceptible to treatment with penicillin are readily controlled by intramuscular administration of 20,000 units every four hours until a total of 300,000 to 500,000 units has been given. Patients who have chronic mixed infections are benefited by destruction of susceptible organisms; however, response is slower and total doses of from 2,000,000 to 3,000,000 units are required. Mathé also recommends lavage of surgical wounds with 250 units of penicillin per cubic centimeter of isotonic solution of sodium chloride and states that the wider use of penicillin in operative wounds offers great promise.

Streptomycin.—Pulaski [43] states that streptomycin shows its most important action against gram-negative organisms including Escherichia coli, Proteus vulgaris, Aerobacter aerogenes, Klebsiella pneumoniae and Pseudomonas aeruginosa. It is also potent against gram-positive cocci, especially nonhemolytic streptococcus. Concentrations of from 500 to 2,000 micrograms of streptomycin per cubic centimeter of urine can be achieved by restricting the fluid intake to 2,500 cc. per day and admin-

42. Mathé, C. P.: Penicillin Therapy as an Adjunct to Genitourinary Surgery, Am. J. Surg. **71**:233-241 (Feb.) 1946.

43. Pulaski, E. J.: Streptomycin in Surgical Infections: II. Infections of the Genito-Urinary Tract, Ann. Surg. **124**:392-401 (Aug.) 1946.

istering 0.4 Gm. of the drug intramuscularly every four hours. These concentrations are sufficient to sterilize the urine in most cases when the bacteria are susceptible and when no complicating factors are present. Usually therapy for three days is adequate. The action of the drug is greatest in alkaline mediums. Cases in which treatment is to be given should be selected carefully on the basis of bacterial susceptibility to streptomycin, adequate renal function and absence of obstruction or calculi in the urinary tract. Successful therapy depends on susceptibility of the bacteria, a free flow of urine and adequate dosage. Pulaski treated infections of the urinary tract at the Halloran General Hospital. Eight patients who had paraplegia due to injury of the spinal cord were treated with streptomycin after treatment with penicillin and sulfonamide drugs had failed. In 3 cases streptomycin effected a prompt and lasting sterilization of the urine. In 13 cases of nonvenereal infections of the urinary tract the results were good in 7, fair in 1 and doubtful in 4; in 1 treatment failed.

Cook, Greene and Hinshaw [44] report on the use of streptomycin in 12 cases of genitourinary tuberculosis. The youngest patient was 8 years of age; the oldest, 51 years. Eight patients had tuberculous cystitis with tuberculosis in a solitary kidney, the other having been removed previously because of tuberculosis. The remaining 4 patients had bilateral renal tuberculosis and tuberculous cystitis. Streptomycin was administered intramuscularly every three or four hours, and most of the patients received at least 1 Gm. daily. The shortest period of therapy was thirty-one days, and 1 patient was still receiving streptomycin at the time the report was written, two hundred and fifty-four days after therapy was begun. The writers report the following therapeutic results: (1) alleviation of the vesical symptoms in some cases, (2) decrease in the degree of pyuria, (3) decrease in incidence of positive staining for Mycobacterium tuberculosis in the urine and (4) improved cystoscopic appearance of the bladder. The genitourinary tuberculosis of 2 patients was apparently arrested, for the results of inoculation of guinea pigs formerly reported positive became negative. Cook, Greene and Hinshaw emphasize that streptomycin is not a substitute for surgical treatment in most cases of tuberculosis of the urinary tract. However, its therapeutic effects are encouraging.

Methenamine Mandelate.—Carroll and Allen [45] discuss the treatment of urinary infections with methenamine mandelate. In 200 cases of com-

44. Cook, E. N.; Greene, L. F., and Hinshaw, H. C.: Streptomycin in the Treatment of Tuberculosis of the Urinary Tract, Proc. Staff Meet., Mayo Clin. **21**:277-280 (July 24) 1946.

45. Carroll, G., and Allen, H. N.: The Treatment of Urinary Infections with Mandelamine (Methenamine Mandelate): A Clinical Study of Two Hundred Cases, J. Urol. **55**:674-681 (June) 1946.

mon urinary infections the drug has proved to be effective in 147 (approximately 74 per cent). When methenamine mandelate was given, the average time required to sterilize the urine was six days, although some conditions, such as pyelitis, were favorably affected in three days, whereas in infections associated with deep-seated or obstructive lesions, as long as two weeks were required before favorable response was obtained.

Methenamine mandelate was found to be virtually nontoxic in therapeutic doses. Mild untoward symptoms which might be attributed to the drug occurred in less than 3 per cent of the cases.

The administration of methenamine mandelate maintained an acid urine without dietary restriction or other drug therapy, except in those cases in which urea-splitting organisms were present. In these cases (4 per cent of the cases in the series) the urine remained alkaline despite an acid-ash diet and administration of ammonium chloride.

From this study it is evident that methenamine mandelate is an efficient urinary antiseptic of low toxicity and broad therapeutic activity in urinary infections. Its nontoxic nature and effective antibacterial action against the organisms most frequently encountered in the urinary tract establish this drug as a valuable agent for controlling common urinary infections.

UROGRAPHY

Kearns, Hefke and Morton [46] report on the use of bis-diethanolamine N-methyl-3,5-diiodo-chelidamate, a new excretory urographic medium. The medium was injected one thousand two hundred and eighty times in 1,232 cases. Reactions and diagnostic value of the resulting roentgenograms were recorded in 915. After preliminary catharsis and a night of fasting, each patient was given an injection of 30 cc. of a 67 per cent solution of this medium.

Evidence of toxicity was carefully investigated in one group of 10 cases in which tests were carried out before injection and after injection of "neo-iopax" N.N.R. and bis-diethanolamine N-methyl-3,5-diiodo-chelidamate. Each patient received alternate injections of the two preparations approximately one week apart. Studies of the chemistry of the blood, including determination of levels of nonprotein nitrogen, sugar and chlorides, were made. In no instance were significant changes in the urine demonstrated after injections. In each instance the patient received the two different injections under identical conditions and the technical setup was exactly duplicated. Consequently the density and detail were the same in the two roentgenograms.

The authors conclude that bis-diethanolamine N-methyl-3,5-diiodo-chelidamate is a safe and satisfactory excretory urographic medium.

---

46. Kearns, W. M.; Hefke, H., and Morton, S. A.: Ditopax—a New Excretory Urographic Medium: A Clinical Report on 1,280 Injections, J. Urol. **56**:392-398 (Sept.) 1946.

In 75 per cent of the 915 cases no untoward reactions were encountered. In the remaining 25 per cent the reactions were largely inconsequential.

The value of bis-diethanolamine N-methyl-3,5-diiodo-chelidamate in roentgenographic diagnosis compares favorably with that of the other commonly used mediums.

It is their opinion, based on observation of a small series of cases, that the diagnostic value is rated in the following order: "neo-iopax," bis-diethanolamine N-methyl-3,5-diiodo-chelidamate and "diodrast" N.N.R.

In their opinion after numerous injections of each preparation bis-diethanolamine N-methyl-3,5-diiodo-chelidamate causes definitely less pain in the arm than "neo-iopax" and less systemic reaction than "diodrast."

Florence, Howland and Weens [47] made intravenous urograms in 23 cases while the patients were having episodes of acute renal colic. In 12 calculi were found to be the cause of renal colic. In the remaining cases ureteral stricture, kinking of the ureters and congenital anomalies of the urinary tract were considered as etiologic factors. In 1 case urographic findings were not abnormal.

Intravenous urography gave information far more valuable than that obtained from survey roentgenograms. The urograms were most valuable in identifying opaque calculi or indicating the presence of ureteral obstruction. They contributed significantly to the diagnosis of renal colic and early clarification of its causation by giving positive information in all but 1 case.

Opacification of the kidney is stressed as a sign of ureteral blockage. It was observed in 5 cases of calculous and 5 cases of noncalculous ureteral obstruction.

Intravenous urography is recommended as a valuable diagnostic procedure in all cases of acute renal colic.

HEMOSTASIS

Fish [48] states that when gauze is oxidized with nitrogen dioxide it undergoes changes. A material that resembles ordinary gauze in appearance and texture results, but its chemical composition so changes that it possesses a pronounced hemostatic quality and becomes completely absorbed in animal and human tissues. Little or no reaction is present in the tissues in contact with the absorbable gauze during the period of its absorption. The rate of absorption depends on the amount of gauze used, the degree of trauma to tissue at the site of insertion and the amount of bleeding. This absorbable hemostatic gauze can be used in

47. Florence, T. J.; Howland, W. S., and Weens, H. S.: Intravenous Urography in Acute Renal Colic, J. Urol. **56**:284-291 (Sept.) 1946.

48. Fish, G. W.: Oxidized Cellulose (Absorbable Hemostatic Gauze; Cellulosic Acid): Its Use in Genito-Urinary Surgery, J. Urol. **56**:375-382 (Sept.) 1946.

any tissue of the body to control bleeding not controllable by clamp, ligature, suture or coagulation, and clinically it is nonirritating. Its hemostatic quality would seem in part to be due to a specific combination of the gauze with hemoglobin in solution or in the tissues. In combining with hemoglobin the gauze turns dark brown. When placed in contact with whole blood the gauze rapidly forms a brownish gelatinous mass and the bulk increases.

Fish first used the material for packing the prostatic bed following suprapubic prostatectomy. The result of this first trial was excellent, and since that time it has been used by him in more than 100 surgical urologic cases.

Some important technical details must be carried out if the gauze is to be used successfully. First and foremost, unless the gauze comes into intimate contact with a bleeding surface it cannot exert its hemostatic effect, and where active oozing is present the gauze must be kept in contact with the bleeding surface until hemostasis is established. This can be done by tamponading with ordinary gauze packing or by gauze sponge stick and sponge. Pressure rarely needs to be applied for more than two or three minutes. Secondly, a sufficient quantity of the gauze must be used to cover completely the entire area of bleeding, be it brain, liver, prostatic bed or kidney. Failure to carry out these two fundamental procedures will result in hemorrhage.

The gauze has been used for packing the prostatic bed following suprapubic prostatectomy in 108 cases. The gauze was first used in the form of 6 inch (15.2 cm.) squares of four ply material. This was not entirely satisfactory, and 2 by 18 inch (about 5 by 46 cm.) four ply rolls were used. After prostatic enucleation the gauze is put into the prostatic bed with sponge forceps and is pressed gently but firmly into the cavity. Pressure is then applied with a sponge stick for two to three minutes. One roll of 2 by 18 inch gauze is usually sufficient, but when large glands have been removed it may be necessary to use two to four of these rolls to cover the bleeding surface completely. When hemostasis has been established, the bladder is closed about a suprapubic tube in the usual manner. As a rule, the suprapubic tube is removed on the fourth postoperative day. Usually the gauze is absorbed completely by the tenth postoperative day. When large quantities of the gauze have been used and it seems advisable to hasten its removal the bladder may be irrigated daily through the suprapubic sinus with a 5 per cent solution of sodium bicarbonate, as the absorbable gauze readily dissolves in weak alkaline solution.

An absorbable hemostatic packing of this kind seems to possess the following distinct advantages: The amount of postoperative bleeding has been greatly reduced by this material as compared to packing with ordinary gauze or with hemostatic catheters or bags; secondary hemor-

rhage after removal of ordinary gauze packing and the unavoidable pain of removal have been done away with. One other possible source of trouble must not be overlooked. If a large amount of absorbable gauze has been used and it has been tightly packed in the prostatic bed, healing may be more rapid than the absorption of the gauze, and when the patient is ready to void some of the material may still be present in the lower part of the prostatic bed. Under such circumstances the passage of a silk or metal catheter through the urethra will dislodge the unabsorbed material and the bladder may be irrigated from below with a 5 per cent solution of sodium bicarbonate.

The bleeding encountered in renal incisions of any type can be well controlled in almost every instance by proper application of absorbable gauze. Here again pressure for a short time is important. It was found that 2 by 2 inch (about 5 by 5 cm.) four ply gauze packs and 4 by 4 inch (about 10 by 10 cm.) four ply gauze packs are the most useful. These pieces may be made into small tufts or wicks and placed in the site of incision for nephrostomy and held in place with plain catgut mattress sutures.

When large staghorn calculi are removed by splitting the kidney from pole to pole and the actively bleeding vessels ligated, a thin pad of absorbable gauze is placed between the halves of the kidney and held in place with three or four large mattress sutures of no. 0 catgut. The gauze is particularly useful for the control of bleeding in renal beds from which large adherent kidneys have been removed and when a bed of scar tissue or an oozing bed such as those encountered in tumors presents a problem in hemostasis. In these cases the 6 by 6 inch (about 15 by 15 cm.) pieces of four ply gauze as a postoperative packing are excellent. They are also useful at the site of various renal incisions familiar to every urologic surgeon. The bleeding at the site from which a renal specimen has been removed for biopsy is easily controlled when small pieces of the gauze are applied with fine mattress sutures of plain catgut.

The Foley-Hendrickson bag which is designed especially for hemostasis with clotting agents was found by Hendrickson [49] to be extremely effective in 470 transurethral resections of the prostate gland.

The value of cloth tampons saturated with clotting agents in promoting hemostasis has been demonstrated in animals and confirmed clinically. The problem of control of bleeding following suprapubic prostatectomy has been solved without incurring the risk of infection and secondary hemorrhage, which so frequently have followed the use of the ordinary gauze pack.

---

49. Hendrickson, F. C.: Topical Use of Clotting Agents in Surgery of the Prostate Gland, J. Urol. **55**:613-617 (June) 1946.

STEEL SUTURES

Powell [50] discusses the use of alloy stainless steel wire in the closure of urologic wounds in 37 surgical cases. Renal, ureteral and prostatic operations and operations on the bladder were performed in these cases. The general procedure is as follows: The wire should be kept on a spool to prevent kinking or twisting. The wire is cut in 8 inch (about 20 cm.) lengths with a wire cutter or a pair of scissors and is threaded through a large, curved cutting needle. Approximately 2 inches (about 5 cm.) of the wire is bent back after the end of the wire is passed through the eye of the needle. Using a needle holder, the suture is carefully placed to approximate the wound edges in the usual stay suture technic. The suture is inserted through skin, muscles and fascial layers in that order and is drawn out the other side of the wound through these tissues in reverse order. Sutures are placed every ½ to 1½ inches (1.3 to 3.8 cm.) in order to secure adequate approximation. All sutures are placed before any is tied. After the first throw is tied, the assistant grasps it with the end of a hemostat without clamping. The surgeon then ties the second throw of a square knot, taking care to evert the margins of the skin. If necessary, interrupted "dermal" sutures can be placed to approximate edges of skin. The technic allows for rapid closure, quick healing, minimal tissue reaction and good functional results.

Alloy stainless steel wire possesses the following advantages that would seem to make it an almost ideal suture: It (1) has high tensile strength per unit of diameter; (2) does not give rise to capillary action; (3) is malleable; (4) is not affected by any body fluids; (5) gives rise to minimal tissue reaction; (6) is relatively easy to handle; (7) is inexpensive; (8) is easy to sterilize, and (9) is able to stand repeated sterilization.

Its disadvantages are that: (1) kinking or twisting weakens its tensile strength; (2) the ends of the suture tend to stick gloves, fingers of the surgeon or both; (3) there is almost complete lack of elasticity, and (4) wire cannot be used to suture renal parenchyma, ureter or vesical wall.

WAR WOUNDS

Kimbrough [51] reports on war wounds of the urogenital tract and the treatment of neurogenic bladder (neurogenic vesical dysfunction). Hematuria was the most common symptom of wounds of the kidney, and the importance of conservative treatment rather than early exploratory operation in cases of renal injury is emphasized.

---

50. Powell, N. B.: The Use of Alloy Stainless Steel Wire in Closing Urological Wounds, J. Urol. **56**:35-45 (July) 1946.

51. Kimbrough, J. C.: War Wounds of the Urogenital Tract, J. Urol. **55**: 179-189 (Feb.) 1946.

Ureteral injuries are rare probably because they are associated with such severe injuries that death occurs before the patients reach hospital facilities. Ureteral injuries should be repaired at the first operative procedure.

Early determination of the extent of injury of the bladder is imperative, as early drainage, usually by cystostomy, is necessary in cases of penetrating wounds. Rarely is drainage by means of a catheter satisfactory. In general, the important aspects of treatment in injury of the bladder are (1) control of hemorrhage and shock, (2) drainage by cystostomy and (3) repair of the wound.

Kimbrough states that the type and gravity of vesical dysfunction depend on the location of the lesion of the brain or cord and the severity of the damage. As soon as the presence of neurogenic bladder is determined, insert a urethral catheter and leave it in place until the patient recovers, dies or undergoes cystostomy. Maintain continuous catheter drainage (tidal or otherwise) until vesical function is recovered, or it is determined that recovery will not occur. Perform suprapubic cystostomy at the end of four weeks, or earlier if definite evidence of return of vesical function is not found, provided that the general condition of the patient is such that the operation offers reasonable life expectancy.

Do not permit the bladder to become overdistended. Do not depend on spontaneous overflow or manual expression of urine. Do not depend on intermittent catheterization. Do not leave the catheter in place in the presence of severe infection.

INDEX TO VOLUME 54

Abbett, K. H.: Incised wounds of head inflicted by bayonets, 121

Abdomen: See also Pelvis; Peritoneum; etc.
abdominal actinomycosis, 434
newer methods of abdominal drainage, 365
thoracicoabdominal approach to upper portion of abdomen and upper pole of kidney, 517

Abnormalities and Deformities: See also under names of diseases, organs and regions, as Foot, deformities; Kidneys; Knee; Sacrum; Urachus; Ureters; etc.
congenital deformities, 91
fracture deformities, 660

Abscess: See also under names of organs and regions
nondrainage and early ambulation in cases of perforative appendicitis (with peritonitis or abscess formation), 644

Accidents: See Trauma; etc.

Acetabulum: See Hip

Acid, Ascorbic: See Ascorbic Acid

Acromioclavicular Joint: See Shoulder

Actinomycosis, abdominal, 434

Adair, F. E.: Effect of estrogenic hormone on advanced carcinoma of female breast, 1

Albright's Syndrome: See Osteitis fibrosa

Alldredge, R. H.: Fractures, 571

Allen, C.: Conditions involving knee joint, 682

American Academy of Orthopaedic Surgeons; progress in orthopedic surgery for 1945; review prepared by Editorial Board, 85, 191, 316, 445, 566, 660

Analgesia: See Anesthesia

Anastomosis: See under Aorta

Anemia, splenic; Gaucher's disease, 90

Anesthesia: See also Surgery
injection of procaine hydrochloride for dislocation of ankle, 215
isolated paralysis of serratus magnus following surgery; report of case, 656

Anesthetics: See Anesthesia

Angioma; vascular tumors, 109

Ankle: See also Foot; Malleoli
conditions involving foot and ankle, 201
dislocation, 214
dislocation; injection of procaine hydrochloride, 215

Ankylosis: See under Hip

Anomalies: See Abnormalities and Deformities; and under names of diseases, organs and regions

Antisepsis and Antiseptics: See under Urinary Tract

Aorta, thoracic, permanent intubation of, 382

Apparatus: See also Fractures; Instruments
devices for external fixation of fractures, 599
newer methods of abdominal drainage, 365
permanent intubation of thoracic aorta, 382

Appendicitis, perforative, nondrainage and early ambulation in cases of, 644

Appendix, Abscess: See Appendicitis

Armies: See Military Medicine

Arms: See Extremities; Forearm; Humerus; Radius; etc.

Arteries: See also Aorta; Blood, pressure; Blood, vessels; etc.
arteriography of kidneys, 707
functional survival of autogenous and homogenous transplants of blood vessels; experimental study, 529

Arteriography: See Arteries

Arthritis: See also Gout; and under names of joints, as Hip; etc.
chronic, 349
diagnosis, 351
etiology, 349
general therapy, 362
other methods of treatment, 360
pyogenic and tuberculous, 316
Reiter's disease, 248, 353
rheumatoid, of spine, 356
surgical treatment of, 358
therapy with gold compounds, 359

Arthrodesis: See under Hip

Arthroplasty: See Hip

Ascorbic Acid; vitamin C in gastric resection for peptic ulcer, 117

Atrophy: See also under names of organs and regions
muscular, dystrophy and syringomyelia, 570

Avitaminosis: See under Vitamins

Azotemia: See Blood, urea

Babcock, W. W.: Newer methods of abdominal drainage, 365

Bacilli: See Bacteria

Bacteria: See also Staphylococci; etc.
Actinobacilli: See Actinomycosis
antibacterial agents in renal surgery, 723
streptomycin and parachlorophenol in surgical infections, 305

Bartlett, R. W.: Management of colostomies in Fifteenth Hospital Center (England), 269

Bayonets, incised wounds of head inflicted by, 121

Bennett, R. L.: Poliomyelitis; convalescent treatment and related subjects, 476

Berg, B. N.: Gastric ulcers produced experimentally by vascular ligation, 58

Bhajekar, M. V.: Strangulated inguinal hernia; observations in 50 cases, 41

Bisgard, J. D.: Bilateral lobectomy for bilateral bronchiectasis, 483

Bladder: See also Urinary Tract
foreign body in, 235
malacoplakia, 233
pyelitis, ureteritis and cystitis cystica, 722
rupture, 234
tumor, 229

Blast: See Explosions

Blevins, G. C.: Seamless prosthetic hands; technic of fabrication, 491

Blood, Diseases: See Anemia; etc.
iodine studies; blood iodine in nonthyroid disease, 541
pressure, high; renal hypertension, 245
pressure, high; renal neurosurgery for hypertension, 709
transfusion, incompatible, peritoneal irrigation for uremia following; report of case, 374

Blood—Continued
urea; peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
vessels, functional survival of autogenous and homogenous transplants of; experimental study, 529
vessels; gastric ulcers produced experimentally by vascular ligation, 58
vessels; strangulated inguinal hernia; observations in 50 cases, 41

Bones: See also under names of bones
benign osteogenic tumors, 104
classification of bone tumors, 114
Deformities: See Abnormalities and Deformities; Osteitis deformans; Poliomyelitis; Rickets; etc.
Diseases: See also Osteitis; Osteochondritis; Osteomyelitis; etc.
diseases of growing and adult bone, 85
eosinophilic granuloma, 103
Ewing's sarcoma, 109
fibroblastic tumors, 105
Fractures: See Fractures
giant cell tumors, 106
growth, 85
infections of bones and joints, 324
malignant osteogenic sarcoma, 111
medullary nailing, 596
metastatic tumors, 112
phosphatase of, 91
plasticity, 87
Tuberculosis: See Tuberculosis
tumors of bone and synovial membrane, 102
use of small threaded wires in treatment of fractures; their use in fixation of bone grafts, 170
vascular tumors, 109

Brain; partial excision of motor cortex in treatment of jacksonian convulsions; results in 41 cases, 633

Breast; effect of estrogenic hormone on advanced carcinoma of female breast, 1

Bronchi; bilateral lobectomy for bilateral bronchiectasis, 483

Bronchiectasis, bilateral, bilateral lobectomy for, 483

Brooke, W. S.: Streptomycin and parachlorophenol in surgical infections, 305

Burns; burned and traumatized hands, 249
streptomycin and parachlorophenol in surgical infections, 305

Burton, J. F.: Method of correction of ectopia cordis, 79

Calcification, 91

Calcinosis: See Calcification

Calcium and Calcium Compounds; absorption of calcium by normal and tuberculous subjects under different dietary conditions, 323

Calculi: See under Kidneys; Ureters; etc.

Cancer: See also Sarcoma; Tumors; and under names of organs and regions, as Breast; Prostate; Ureters; etc.
metastatic tumors, 112

Capitulum: See Humerus

Carcinoma: See Cancer

Cardiovascular System: See Arteries; Heart; etc.

Carpus: See Wrist

Cartilage: See Osteochondritis; etc.

Caruncle: See Urethra

Casts: See also Fractures
hanging, in compound fractures of humerus, 572

Cellulose, absorbable hemostatic gauze, 728

Cerebrum: See Brain

Cervix: See under Uterus

Chemotherapy: See under names of diseases and chemotherapeutic agents, as Actinomycosis; Penicillin; Sulfonamides; Wounds; etc.

Chest: See Thorax

Children: See also Infants
fractures of elbow, 574

Chondrosarcoma; thoracicoabdominal approach to upper portion of abdomen and upper pole of kidney, 517

Christian-Schüller Disease: See Schüller-Christian Disease

Clarke, C. D.: Seamless prosthetic hands; technic of fabrication, 491

Clubfoot: See Foot, deformities

Colles Fracture: See Radius, fractures

Colostomy, management in Fifteenth Hospital Center (England), 269

Conjunctivitis; Reiter's disease, 248, 353

Contracture; spasm and pain in poliomyelitis; methods of relieving, 479

Convulsions, jacksonian; partial excision of motor cortex in treatment; results in 41 cases, 633

Cook, E. N.: Review of urologic surgery, 220, 701

Coracoclavicular Joint: See Shoulder

Cotton; granulomas caused by surgical silk and cotton sutures, 37

Coumarin Therapy: See Thrombosis

Coventry, M. B.: Conditions involving knee joint, 682

Curtis, G. M.: Blood iodine studies; blood iodine in nonthyroid disease, 541

Cystitis: See Bladder

Cysts: See under names of organs and regions

Dactylitis: See Fingers and Toes

Deformities: See Abnormalities and Deformities; and under names of diseases, organs and regions, as Spine; etc.

Dicumarol: See Thrombosis

Diet and Dietetics: See Nutrition; Vitamins

Diethylstilbestrol: See Estrogens

Digestive System: See Intestines; Stomach; etc.

Disk, Intervertebral: See under Spine

Dislocations: See Ankle; Hip; Knee; Patella; Shoulder; etc.

Ditopax: See Urinary Tract

Diverticula: See Intestines; Urethra; etc.

Donors: See Blood, transfusion

Douglas, R. V.: Abdominal actinomycosis, 434

Dragstedt, L. R.: Patent omphalomesenteric duct and its relation to diverticulum of Meckel, 10

Drainage: See also under Appendicitis
abdominal; newer methods, 365

Dressings; absorbable hemostatic gauze, 728

Dunlop Method: See Fractures

Duodenum, Ulcers: See Peptic Ulcer

Dystrophy, muscular, atrophy and syringomyelia, 570

Ectopia Cordis: See Heart

Ejaculatory Ducts: See Seminal Vesicles

Elbow; fractures in children, 574

Elliott, R. B.: Conditions involving knee joint, 682
Endocrine Therapy: See under names of glands and hormones
Enuresis: See Urination, incontinence
Eosinophils; eosinophilic granuloma of bone, 103
Epidemiology: See under names of diseases, as Poliomyelitis; etc.
Epididymis, tumors, 718
Epilepsy: See Convulsions
Epiphyses, slipped femoral, 199
Erythrocytes: See Anemia; etc.
Estradiol Benzoate: See Estrogens
Estrogens; effect of estrogenic hormone on advanced carcinoma of female breast, 1
for prostatic carcinoma, 713
Ewing Sarcoma: See Sarcoma
Explosion; blast scrotum, 236
Extremities: See also under names of bones
artificial; seamless prosthetic hands; technic of fabrication [with use of rubber latex], 491
lower; fractures, 580
lower; use of small threaded wires in treatment of fractures, 138
upper; fractures, 571
upper; use of small threaded wires in treatment of fractures, 154

Fahey, J. J.: Conditions involving hip joint, 191
Farris, E.: Abdominal actinomycosis, 434
Fascia; living fascial sutures in inguinal herniorrhaphy, 414
Femur: See also Hip
Epiphyses: See Epiphyses
fractures of neck, 583
fractures of shaft, 585
fresh fractures of neck of, 191
intertrochanteric fractures, 195, 582
march fractures of neck of, 195
problem of stiff knee joint in fracture of shaft of femur, 660
Fertman, M. B.: Blood iodine studies; blood iodine in nonthyroid disease, 541
Fetus: See Pregnancy
Fibrosarcoma of bone, 105
Fibula; fractures of shaft of tibia and fibula, 590
Fingers and Toes: See also Foot; Hand; etc.
hallux valgus, 207
tuberculous dactylitis in adults, 67
Flashman, F. L.: Tumors of bone and synovial membrane, 102
Flynn, J. E.: Burned and traumatized hands, 249
Flynn, J. F.: Review of urologic surgery, 220, 701
Foley Hendrickson Bag: See Hemostasis
Foot: See also Ankle; Fingers and Toes; etc.
conditions involving foot and ankle, 201
deformities; sacral agenesis [and clubfoot]; report of case, 430
diseases of, 209
fractures, 594
Madura: See Mycetoma
static strain on feet, 201
trench foot and immersion foot, 204
Foramen, Intervertebral: See under Spine
Forearm, fracture, 575
Foreign Bodies in bladder, 235
Fractures: See also under names of bones and joints
about hip joint, 580
at wrist, 576
Casts: See Casts
Colles: See Radius, fractures
complications; injuries to nerves, 605
compound, 605
deformities, 660
devices for external fixation, 599
fixation with Kirschner wire, 601
healing of, 611
in foot, 594
intertrochanteric, 582
malleolar, 591
of elbow in children, 574
of forearm, 575
of head of radius, 575
of humerus, 571
of lower extremities; use of small threaded wires in treatment, 138
of lower extremity, 580
of neck of femur, 583
of patella, 589
of shaft of femur, 585
of spine and pelvis, 602
of upper extremities; use of small threaded wires in treatment, 154
of upper extremity, 571
operative fixation, 596
problem of delayed union and nonunion of, 662
special, 610
transcondylar, of humerus treated by Dunlop method, 574
use of small threaded wires in treatment; their use in fixation of bone grafts, 179
Fungi: See Actinomycosis; etc.

Gangrene, gas, 334
Gas Gangrene: See Gangrene, gas
Gaston, E. A.: Living fascial sutures in inguinal herniorrhaphy, 414
Gastrectomy: See under Stomach
Gastric Ulcer: See Peptic Ulcer
Gastroduodenal Ulcer: See Peptic Ulcer
Gastrointestinal Tract: See Intestines; Stomach; etc.
Gaucher's Disease: See Anemia, splenic
Gauze: See Dressings
Genitals: See Genitourinary Tract; Urinary Tract; and under names of genitals, as Penis; etc.
Genitourinary Tract: See also Urinary Tract
penicillin therapy as adjunct to genitourinary surgery, 725
streptomycin in infections of, 725
war wounds of urogenital tract, 731
Ghormley, R. K.: Conditions involving knee joint, 668
Gill, A. B.: Congenital dislocation of hip, 218
Gold Therapy: See Arthritis
Gonorrhea, treatment, 247
Gout, 354
Graham, R. J.: Conditions involving knee joint, 668
Granuloma, eosinophilic, of bone, 103
caused by surgical silk and cotton sutures, 37
Greenberg, B. B.: Tuberculous dactylitis in adults, 67
Groin; anatomy and physiology of inguinal region, 414
Gunshot Wounds: See Wounds
Gutierrez, R.: Review of urologic surgery, 220, 701

Hallux Valgus: See Fingers and Toes
Hand: See also Fingers and Toes
Artificial: See Extremities, artificial
burned and traumatized, 249
fractures of hand and wrist, 664
Hand-Schüller-Christian Disease: See Schüller-Christian Disease
Harper, F. R.: Thoracicoabdominal approach to upper portion of abdomen and upper pole of kidney, 517
Hauser, E. D. W.: Conditions involving foot and ankle, 201
Head: incised wounds inflicted by bayonets, 121
Heart: method of correction of ectopia cordis, 79
Heine-Medin Disease: See Poliomyelitis
Hematology: See Blood
Hemorrhage: See also Hemostasis; etc.
traumatic rupture of liver without penetrating wounds; study of 32 cases, 613
Hemostasis (use of Foley Hendrickson bag), 728
Heparin Therapy: See Thrombosis
Hepler, A. B.: Review of urologic surgery, 220, 701
Hernia, inguinal: living fascial sutures in inguinal herniorrhaphy, 414
inguinal, strangulated; observations in 50 cases, 41
Herniorrhaphy: See Hernia, inguinal
Herrmann, J. B.: Effect of estrogenic hormone on advanced carcinoma of female breast, 1
Hill, L. M., Jr.: Traumatic rupture of liver without penetrating wounds; study of 32 cases, 613
Hinman, F.: Review of urologic surgery, 220, 701
Hip: See also Femur
arthritis of, 197
arthrodesis, 197
arthroplasty, 200
arthroplasty in ankylosis of, 358
conditions involving hip joint, 191
dislocation, 197
dislocation, congenital, 218
fractures, 196, 580
neurectomy for arthritis of, 198
osteoarthritis of, 198
Holbrook, T. J.: Partial excision of motor cortex in treatment of jacksonian convulsions; results in 41 cases, 633
Holden, W. D.: Treatment of deep venous thrombosis with reference to subcutaneous injection of heparin and use of dicumarol, 183
Hormones, Estrogenic: See Estrogens
Hufnagel, C. A.: Permanent intubation of thoracic aorta, 382
Humerus, fractures, 571
transcondylar fractures treated by Dunlop method, 574
Hydatid of Morgagni: See Testes
Hydronephrosis, 701
Hyperparathyroidism: See Parathyroid
Hypertension: See Blood pressure, high
Hypertrophy: See Prostate

Ileum: See Intestines
Ileus: See Intestines
Immersion Foot: See under Foot
Incontinence: See Urination
Infantile Paralysis: See Poliomyelitis
Infants; congenital hypertrophic pyloric stenosis, 555
Infection: See also Wounds; and under names of bacteria
of bones and joints, 324
surgical, streptomycin and parachlorophenol in, 305
treated with penicillin, 326
Inguinal Region: See Groin
Injuries: See Trauma; and under names of diseases, organs and regions, as Head; Knee; etc.
Instruments: See also Apparatus
management of colostomies in Fifteenth Hospital Center (England), 269
Intervertebral Disks: See Spine
Intestines; management of colostomies in Fifteenth Hospital Center (England), 269
newer methods of abdominal drainage, 365
patent omphalomesenteric duct and its relation to diverticulum of Meckel, 10
strangulated inguinal hernia; observations in 50 cases, 41
Ulcers: See Peptic Ulcer
Iodine and Iodine Compounds; blood iodine studies; blood iodine in nonthyroid disease, 541
Irwin, C. E.: Infantile paralysis, 445
Ivins, J. C.: Conditions involving knee joint, 668

Jackson, A. E.: Conditions involving knee joint, 682
Jackson, A. S.: Nondrainage and early ambulation in cases of perforative appendicitis, 644
Jacksonian Convulsions: See Convulsions
Janes, J. M.: Conditions involving knee joint, 668
Jaws, conditions involving, 699
Jejunum: See Intestines
Ulcers: See Peptic Ulcer
Jenkins, H. P.: Patent omphalomesenteric duct and its relation to diverticulum of Meckel, 10
de Jesus Zerbini, E.: Vitamin C in gastric resection for peptic ulcer, 117
Johnson, E. W.: Conditions involving knee joint, 682
Joints: See also under names of individual joints, as Elbow; Hip; Knee; etc.
infections of bones and joints, 324
Inflammation: See Arthritis
Tuberculosis: See Tuberculosis

Kenny Treatment: See Poliomyelitis
Kidneys: See also Urinary Tract
anomalies, 220, 702
arteriography, 707
calculi, 222, 702
Diseases: See Hydronephrosis
nephroptosis, 220
peritoneal irrigation for uremia following incompatible blood transfusion, 374
polycystic disease, 223
prevention of renal complications by therapeutic employment of sulfonamide mixtures; sulfathiazole-sulfadiazine combination, 724
pyelitis, ureteritis and cystitis cystica, 722
renal hypertension, 245
renal neurosurgery for hypertension, 709
surgery, antibacterial agents in, 723
thoracicoabdominal approach to upper portion of abdomen and upper pole of kidneys, 517
tuberculosis, 223, 707
tumors, 221, 704

Kirschner Method: See Fractures
Kite, J. H.: Congenital deformities, 91
Kittle, C. F.: Patent omphalomesenteric duct and its relation to diverticulum of Meckel, 10
Knee: See also Patella; Semilunar Cartilages
administration of penicillin in osteomyelitis by knee joint method, 326
cartilage, pathognomonic sign for cyst of, 188
conditions involving knee joint, 668, 682
congenital anomalies, 669
dislocations, 676
internal derangement, 673, 683
pathologic conditions of, 670
Pellegrini-Stieda disease, 686
physical medicine, 687
problem of stiff knee joint in fracture of shaft of femur, 660
roentgen diagnosis, 682
roentgenologic examination, 677
surgical procedure, 678
wounds of, 683
wounds and injuries of, 672
Kristoff, F. V.: Ruptured intervertebral disk in cervical region; report of 20 cases, 287
Kuhns, J. G.: Chronic arthritis, 349
Kuntscher Nails: See under Fractures

Latex: See under Resins
Legs: See Extremities; Foot; Knee; and under names of bones
Artificial: See Extremities, artificial
Lewin, P.: Infections of bones and joints, 324
Lichtor, A.: Sacral agenesis; report of case, 430
Ligaments: See Ankle; Knee
Triangular: See Wrist
Ligatures: See Sutures
Liver, traumatic rupture without penetrating wounds; study of 32 cases, 613
Lobectomy: See under Lungs
Lorhan, P. H.: Isolated paralysis of serratus magnus following surgery; report of case, 656
Lucite: See under Methacrylates
Lungs: See also Thorax; etc.
bilateral lobectomy for bilateral bronchiectasis, 483

McBride, R. B.: Peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
McCarroll, H. R.: Use of small threaded wires in treatment of fractures; fractures of lower extremities, 138
Use of small threaded wires in treatment of fractures; fractures of upper extremities, 154
Use of small threaded wires in treatment of fractures; their use in fixation of bone grafts, 170
Madura Foot: See Mycetoma
Malacoplakia: See Bladder
Malleoli, fractures, 591
Mammary Gland: See Breast
Mandible: See Jaws
Mann, F. C.: Functional survival of autogenous and homogenous transplants of blood vessels; experimental study, 529
March Fractures: See under Femur
Maxillary Bone: See Jaws
Meacham, W. F.: Partial excision of motor cortex in treatment of jacksonian convulsions; results in 41 cases, 633
Meckel's Diverticulum: See Intestines
Medicine, Military: See Military Medicine
Medin-Heine Disease: See Poliomyelitis
Meniscus: See Semilunar Cartilages
Mesentery; strangulated inguinal hernia; observations in 50 cases, 41
Methacrylates; permanent intubation of thoracic aorta [use of methyl methacrylate], 382
Methenamine: See Urinary Tract
Methyl Methacrylate: See Methacrylates
Myerding, H. W.: Tumors of bone and synovial membrane, 102
Micturition: See Urination
Military Medicine; burned and traumatized hands, 249
incised wounds of head inflicted by bayonets, 121
internal derangement of knee, 683
management of colostomies in Fifteenth Hospital Center (England), 269
march fractures of neck of femur, 195
static strain on feet, 201
trench foot and immersion foot, 204
Montgomery, R. P.: Conditions involving foot and ankle, 201
Muirhead, E. E.: Peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
Muscles, Atrophy: See Atrophy, muscular
disorders, 570
Dystrophy: See Dystrophy, muscular
Paralysis: See Paralysis
traumatic degeneration of head of gastrocnemius muscle, 687
Mycetoma, 330, 338

Nafe, C. A.: Congenital hypertrophic pyloric stenosis, 555
Narcosis: See Anesthesia
Neck, conditions involving, 696
Nephrectomy: See under Kidneys
Nerves: See also Paralysis
Blocking: See under Anesthesia
injuries; fracture complications, 605
neurectomy for arthritis of hip, 198
neuromuscular disorders exclusive of poliomyelitis, 566
traumatic conditions, 571
Nervous System: See Brain; Nerves; Spinal Cord; etc.
Neurosurgery: See under Kidneys
Nicola, T.: Conditions involving shoulder, neck and jaw, 689
Nipple: See Breast
Nucleus Pulposus: See under Spine
Nutrition; congenital malformations induced by maternal nutritional deficiency, 91

O'Conor, V. J.: Review of urologic surgery, 220, 701
Odom, G. L.: Ruptured intervetebral disk in cervical region; report of 20 cases, 287
O'Donoghue, D. H.: Fractures, 571
Ointments; streptomycin and parachlorophenol in surgical infections, 305
Omphalomesenteric Duct, patent, and its relation to diverticulum of Meckel, 10
Operating Rooms: See Surgery
Orchitis: See Testes
Orr, T. G.: Granulomas caused by surgical silk and cotton sutures, 37
Modified technic for total gastrectomy, 279

Orthopedic Surgery, progress for 1945; review prepared by Editorial Board of American Academy of Orthopaedic Surgeons, 85, 191, 316, 445, 566, 660
syphilis as it affects orthopedic surgery, 335
Orthopedics: See Bones; Fractures; Poliomyelitis; etc.
Os Centrale: See Wrist
Osteitis deformans, 87
fibrosa; fibrous dysplasia of bone, 89
fibrosa cystica, 102
Osteoarthritis of hip, 198
Osteochondritis, 87
Osteomyelitis, acute; penicillin in treatment, 331
administration of penicillin by knee joint method, 326
sulfa drug therapy in management of, 327
use of skin grafts, 325

Padilla, F. L.: Conditions involving knee joint, 668
Tumors of bone and synovial membrane, 102
Paget's Disease of Bones: See Osteitis deformans
Pain: See under Foot; Shoulder; etc.
spasm and contracture in poliomyelitis: methods of relieving pain, 479
Palsy: See Paralysis
Parachlorophenol and streptomycin in surgical infections, 305
Paralysis: See also Poliomyelitis
cerebral palsy, 568
delayed paraplegia following fractures of vertebrae, 666
Infantile: See Poliomyelitis
isolated, of serratus magnus following surgery; report of case, 656
Paraplegia: See Paralysis
Parathyroid, 88
Paschall J., Jr.: Conditions involving knee joint, 682
Patella: See also Knee
chondromalacia, 687
dislocation, recurrent, 682
fractures, 589
recurrent dislocation; surgical technic and results of treatment, 688
Pellegrini-Stieda Disease: See Knee
Penicillin; administration in osteomyelitis by knee joint method, 326
Therapy: See Genitourinary Tract; Infections; Osteomyelitis; etc.
Penis, tumors, 718
Pentothal: See Anesthesia
Peptic Ulcer; gastric ulcers produced experimentally by vascular ligation, 58
surgical treatment; recent experience at Los Angeles General Hospital, 390
vitamin C in gastric resection for, 117
Peritoneum; peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
Peritonitis: See also Appendicitis
nondrainage and early ambulation in cases of perforative appendicitis (with peritonitis or abscess formation), 644
Peterson, L. T.: Fracture deformities, 660
Phalanges: See Fingers and Toes
Phelps, W. M.: Neuromuscular disorders exclusive of poliomyelitis, 566
Phosphatase of bone, 91
Pilcher, C.: Partial excision of motor cortex in treatment of jacksonian convulsions; results in 41 cases, 633
Pils, A. R.: Conditions involving knee joint, 682
Tumors of bone and synovial membrane, 102
Pisani, A. J.: Pathognomonic sign for cyst of knee cartilage, 188
Plaster Technic: See Casts
Plastic Surgery: See Surgery, plastic
Plastics: See under Methacrylates; Resins
Poliomyelitis as affected by intake of vitamin B complex, 465
complications and sequelae, 455
convalescent treatment and related subjects, 476
diagnosis, 447
diagnosis and early treatment, 476
epidemiology, 461
epidemiology and statistics, 449
etiology and pathogenesis, 445
experimental, effect of fatigue, chilling and mechanical trauma on resistance to, 466
infantile paralysis, 445
infantile paralysis; research, 459
methods of relieving spasm, pain and contracture, 479
pathology, 463
prevention, 448
suggested new treatment, 465
survey of epidemics and series of patients, 481
virus, 459
Polyarthritis: See Arthritis
Pregnancy; congenital malformations induced by maternal nutritional deficiency, 91
etiology and pathogenesis of poliomyelitis, 445
pyelitis of, 707
Prepuce: See Penis
Prigot, A.: Traumatic rupture of liver without penetrating wounds; study of 32 cases, 613
Prostate, cancer, 227, 713
cavitary, 229
hypertrophy, 228, 713
Prosthesis: See Extremities, artificial
Prout, H.: Surgical treatment of peptic ulcer; recent experience at Los Angeles General Hospital, 390
Pseudarthrosis, 667
Ptosis: See under Kidneys
Pyelitis: See Kidneys
Pyelography; urography, 727
Pyelonephritis, 707
Pylorus; congenital hypertrophic stenosis, 555
Pyuria: See Urinary Tract, infections

Rachitis: See Rickets
Radius, fracture of head of, 575
fracture; treatment of malunited Colles's fractures, 664
Recklinghausen's Disease: See Osteitis fibrosa
Reiter's Disease: See Arthritis; Conjunctivitis; Urethra, inflammation
Research; infantile paralysis, 459
Resins; seamless prosthetic hands; technic of fabrication [with use of rubber latex], 491
Rheumatism: See Arthritis
Rickets, 90
Roentgen Rays: See under Knee
Rountree, C. R.: Fractures, 571
Rubber: See under Resins

Sacrum, agenesis; report of case, 430
Sarcoma: See Cancer; Chondrosarcoma; Fibrosarcoma; Tumors; and under names of organs and regions
  Ewing's, 109
  malignant osteogenic, 111
Schlesinger, P. T.: Tuberculous dactylitis in adults, 67
Scholl, A. J.: Review of urologic surgery, 220, 701
Schüller-Christian Disease; metabolic lesions, 103
Scrotum, blast, 236
Scurvy, 90
Semilunar Cartilages: See also Knee
  pathognomonic sign for cyst of knee cartilage, 188
Seminal Vesicles; seminal vesiculitis, 722
Shoulder: See also Clavicle; Humerus
  dislocations, 689
  other conditions of, 695
  surgery of shoulder girdle, 694
Siegling, J. A.: Diseases of growing and adult bone, 85
Silk; granulomas caused by surgical silk and cotton sutures, 37
Skeleton: See Bones
Skull: See Cranium
Small, A. B.: Peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
Smith, A. DeF.: Tuberculosis of bones and joints, 316
Sodium chloride; peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
Spasm; pain and contracture in poliomyelitis, methods of relieving, 479
Spermatic Cord, torsion of, 717
Spermatozoa, 719
Spina Ventosa: See Fingers and Toes
Spinal Cord, compression; ruptured intervertebral disk in cervical region; report of 20 cases, 287
Spine: See also Sacrum
  delayed paraplegia following fractures of vertebrae, 666
  fractures, 666
  fractures of spine and pelvis, 602
  rheumatoid arthritis of, 356
  ruptured intervertebral disk in cervical region; report of 20 cases, 287
Spinothalamic Tract: See under Spinal Cord
Splenectomy: See Anemia, splenic
Spondylarthritis: See Spine
Stainless Steel: See Sutures
Staphylococci; treatment of chronic infections, 342
Statistics; surgical treatment of peptic ulcer; recent experience at Los Angeles General Hospital, 390
  surveys of epidemics and series of patients in poliomyelitis, 481
Stenosis: See Pylorus
Sterility, 719
Stieda-Pellegrini's Disease: See under Knee
Stomach: See also Pylorus
  modified technic for total gastrectomy, 279
  Ulcers: See also Peptic Ulcer
  ulcers produced experimentally by vascular ligation, 58
Stomach—Continued
  vitamin C in gastric resection for peptic ulcer, 117
Streptomycin and parachlorophenol in surgical infections, 305
  official statement concerning, 343
  Therapy: See Genitourinary Tract; Tuberculosis; etc.
Stuck, W. G.: Fractures, 571
Sulfadiazine: See Kidneys
Sulfathiazole: See Kidneys; Sulfonamides
Sulfonamides; prevention of renal complications by therapeutic employment of sulfonamide mixtures; sulfathiazole-sulfadiazine combination, 724
  Therapy: See Kidneys; etc.
Surgery: See also Apparatus; Drainage; Wounds; etc.
  isolated paralysis of serratus magnus following surgery; report of case, 656
  plastic; burned and traumatized hands, 249
  plastic; use of skin grafts in osteomyelitis, 325
  streptomycin and parachlorophenol in surgical infections, 305
Sutures: See also under Surgery
  granulomas caused by surgical silk and cotton sutures, 37
  living fascial, in inguinal herniorrhaphy, 414
  use of alloy stainless steel wire in closing urologic wounds, 731
Swenson, S. A., Jr.: Bilateral lobectomy for bilateral bronchiectasis, 483
Synovial Membrane; tumors of bone and synovial membrane, 102
Syphilis: See also under names of organs and regions
  as it affects orthopedic surgery, 335
  etiology and pathogenesis of poliomyelitis, 445
Syringomyelia, muscular atrophy and dystrophy, 570

Talocalcanean Joint: See Ankle
Temporomandibular Joint: See Jaws
Tendons; bicipital tendovaginitis, 692
Tendovaginitis: See Tendons
Testes: See also Epididymis
  appendical torsion (hydatid of Morgagni), 240
  orchitis, 241
  trauma, 236
  tumors, 236, 714
Thompson, G. J.: Review of urologic surgery, 220, 701
Thompson, H. L.: Surgical treatment of peptic ulcer; recent experience at Los Angeles General Hospital, 390
Thorax: See also Heart; Lungs; etc.
  thoracicoabdominal approach to upper portion of abdomen and upper pole of kidney, 517
Thrombosis, deep venous; treatment with reference to subcutaneous injection of heparin and use of dicumarol, 183
Thumb: See Fingers and Toes
Thyroid; blood iodine studies; blood iodine in nonthyroid disease, 541
Tibia; fractures of shaft of fibula and tibia, 590
Toomey, J. A.: Infantile paralysis; research, 459
Tourniquet: See Hemostasis

Transfusion: See Blood, transfusion
Transplantation: See Ureters; etc.
functional survival of autogenous and homogenous transplants of blood vessels; experimental study, 529
Trauma: See also Testes; Ureters; etc.
burned and traumatized hands, 249
traumatic conditions of nerves, 571
traumatic rupture of liver without penetrating wounds; study of 32 cases, 613
Trochanter: See Femur
Trochlea: See Humerus
Tuberculosis: See also under names of diseases organs and regions, as Kidneys; etc.
absorption of calcium by normal and tuberculous subjects under different dietary conditions, 323
experimental, streptomycin in, 322
of bones and joints, 316
tuberculous dactylitis in adults, 67
Tumors: See also Angioma; Cancer; Chondrosarcoma; Fibrosarcoma; Sarcoma; etc.; and under names of organs and regions, as Bladder; Bones; Epididymis; Kidneys; Penis; Testes; etc.
giant cell, 106

Ulcers: See also under names of organs and regions
Peptic: See Peptic Ulcer
streptomycin and parachlorophenol in surgical infections, 305
Umansky, A. L.: Tuberculous dactylitis in adults, 67
Upshaw, J. E.: Conditions involving knee joint, 668
Urachus anomaly, 245
Uremia: peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
Ureteritis: See Ureters
Ureterocele: See Ureters
Ureters: See also Urinary Tract
anomalies, 709
cancer, 225
postcaval, 226
pyelitis, ureteritis and cystitis cystica, 722
stones, 711
transplantation, 223
trauma, 712
ureterocele, 710
Urethra, anatomy, 720
diverticula, 241
duplication, 244
inflammation; Reiter's disease, 248, 353
Urethritis: See Urethra, inflammation
Urinary Tract: See also Genitourinary Tract; Kidneys; Ureters; etc.
ditopax—new excretory urographic medium, 727
infection, 246
treatment of infection, 247
treatment of infections with mandelamine (methenamine mandelate), 726
Urination, incontinence, 226
Urine: See also Urination
peritoneal irrigation for uremia following incompatible blood transfusion; report of case, 374
urinary extravasation, 720
Urography: See Pyleography
Urologic Surgery, review of, 220, 701

Varicocele, 716
Varney, J. H.: Tumors of bone and synovial membrane, 102
Vasomotor System: See Arteries; Veins
Veins: See also Blood vessels; etc.
functional survival of autogenous and homogenous transplants of blood vessels; experimental study, 529
Pressure: See Blood pressure
Venous Pressure: See Blood pressure
Vertebrae: See Spine
Vesiculitis: See Seminal Vesicles
Viruses of poliomyelitis, 459
Vitamins; absorption of calcium by normal and tuberculous subjects under different dietary conditions, 323
B: See Poliomyelitis
C: See Ascorbic Acid
D: calcification, 91
Vultex: See Extremities, artificial

War: See also Wounds; etc.
fractures about hip joint, 580
medullary nailing, 596
use of hanging casts in compound fractures of humerus, 572
wounds of urogenital tract, 731
Weinberg, F. B.: Seamless prosthetic hands; technic of fabrication, 491
Williamson, C. S.: Functional survival of autogenous and homogenous transplants of blood vessels; experimental study, 529
Wires; use of small threaded wires in treatment of fractures of lower extremities, 138
use of small threaded wires in treatment of fractures; their use in fixation of bone grafts, 170
use of small threaded wires in treatment of fractures of upper extremities, 154
Woodard, H. Q.: Effect of estrogenic hormone on advanced carcinoma of female breast, 1
Wounds: See also War
burned and traumatized hands, 249
granulomas caused by surgical silk and cotton sutures, 37
streptomycin and parachlorophenol in surgical infections, 305
use of alloy stainless steel wire in closing urologic wounds, 731
war wounds of urogenital tract, 731
Wright, L. T.: Traumatic rupture of liver without penetrating wounds; study of 32 cases, 613
Wrist, fractures, 576
fractures of hand and wrist, 664

AUG 11 1947

MEDICAL LIBRARY

VOLUME 54 NUMBER 6

ARCHIVES OF SURGERY

EDITORIAL BOARD

WALTMAN WALTERS, Chairman, Rochester, Minn.
LESTER R. DRAGSTEDT, Chicago
ROBERT ELMAN, St. Louis
ALFRED BLALOCK, Baltimore
ALTON OCHSNER, New Orleans
A. J. SCHOLL, Los Angeles
ARTHUR W. ALLEN, Boston
G. E. LINDSKOG, New Haven, Conn.
COBB PILCHER, Nashville, Tenn.

JUNE 1947

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO 10, ILLINOIS. ANNUAL SUBSCRIPTION, $8.00

Entered as Second Class Matter July 10, 1925, at the Postoffice at Chicago, Under the Act of Congress of March 3, 1879

COPYRIGHT, 1947, BY THE AMERICAN MEDICAL ASSOCIATION

THE ARCHIVES OF SURGERY is published by the American Medical Association for the advancement of surgery and as a medium of publication for research, clinical observations and experimental work in surgery.

Manuscripts for publication and correspondence relating to the editorial management, to communications, subscriptions, reprints, etc., should be addressed, ARCHIVES OF SURGERY, American Medical Association, 535 North Dearborn Street, Chicago 10.

Articles are accepted for publication on condition that they are contributed solely to the ARCHIVES OF SURGERY. Manuscripts must be typewritten, preferably double spaced, and the original copy should be submitted. Zinc etchings and halftones will be supplied by the Association when the original illustrations warrant reproduction and when their number is not considered excessive.

Footnotes and bibliographies (the latter are used only in exhaustive reviews of the literature) should conform to the style of the *Quarterly Cumulative Index Medicus*. This requires, in the order given: name of author, title of article and name of periodical, with volume, page, month—day of month if the journal appears weekly—and year.

Matter appearing in the ARCHIVES OF SURGERY is covered by copyright, but as a rule no objection will be made to its reproduction in a reputable medical journal if proper credit is given. However, the reproduction for commercial purposes of articles appearing in the ARCHIVES OF SURGERY or in any of the other publications issued by the Association will not be permitted.

The ARCHIVES OF SURGERY is issued monthly. The annual subscription price (for two volumes) is as follows: domestic, $8.00; Canadian, $8.40; foreign, $9.00, including postage. Single copies are 85 cents, postpaid, except the August 1940 issue, which sells for $1.50.

Checks, money orders and drafts should be made payable to the American Medical Association.

OTHER PERIODICAL PUBLICATIONS
of the American Medical Association

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION—Weekly. Covers all the medical sciences and matters of general medical interest. Illustrated. Annual subscription price (three volumes): domestic, $8.00; Canadian, $9.50; foreign, $12.00. Single copies, 25 cents.

ARCHIVES OF INTERNAL MEDICINE—Monthly. Devoted to the publication of advanced original clinical and laboratory investigations in internal medicine. Illustrated. Annual subscription price (two volumes): domestic, $5.00; Canadian, $5.40; foreign, $6.00. Single copies, 75 cents.

AMERICAN JOURNAL OF DISEASES OF CHILDREN—Monthly. Presents pediatrics as a medical science and as a social problem. Includes carefully prepared reviews, based on recent pediatric literature, abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $8.00; Canadian, $8.40; foreign, $9.50. Single copies, 85 cents.

ARCHIVES OF NEUROLOGY AND PSYCHIATRY—Monthly. A medium for the presentation of original articles on nervous and mental diseases, with abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $8.00; Canadian, $8.40; foreign, $9.50. Single copies, 85 cents.

ARCHIVES OF DERMATOLOGY AND SYPHILOLOGY—Monthly. Devoted to advancing the knowledge of and progress in cutaneous diseases and syphilis. Publishes original contributions and abstracts of the literature on these two subjects, transactions of the important dermatologic societies, book reviews, etc. Illustrated. Annual subscription price (two volumes): domestic, $8.00; Canadian, $8.40; foreign, $9.00. Single copies, 85 cents.

ARCHIVES OF OTOLARYNGOLOGY—Monthly. A medium for the presentation of original articles on diseases of the ear, nose and throat, with abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $6.00; Canadian, $6.40; foreign, $7.00. Single copies, 75 cents.

ARCHIVES OF PATHOLOGY—Monthly. A periodical devoted to the publication of original articles and general reviews in the field of pathology. Illustrated. Annual subscription price (two volumes): domestic, $6.00; Canadian, $6.40; foreign, $7.00. Single copies, 75 cents, except special issues.

ARCHIVES OF OPHTHALMOLOGY—Monthly. Includes original articles on diseases of the eye, abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $8.00; Canadian, $8.40; foreign, $9.00. Single copies, 85 cents.

OCCUPATIONAL MEDICINE—Monthly. Devoted to the advancement of knowledge on the diseases of industry and to the publication of scientific investigation in this field. Illustrated. Annual subscription price (two volumes): domestic, $6.00; Canadian, $6.40; foreign, $7.00, including postage. Single copies, 75 cents.

QUARTERLY CUMULATIVE INDEX MEDICUS—Quarterly. A complete subject and author index to the worth while current medical literature of the world. Issued four times a year. Second and fourth volumes bound for permanent reference. Subscription price, calendar year: domestic, $12.00; Canadian, $14.00; foreign, $14.00.

AMERICAN MEDICAL ASSOCIATION

535 North Dearborn Street **CHICAGO 10**

CONTENTS

PAGE

TRAUMATIC RUPTURE OF THE LIVER WITHOUT PENETRATING WOUNDS: A STUDY OF THIRTY-TWO CASES. **Louis T. Wright, M.D.; Aaron Prigot, M.D., and Lyndon M. Hill Jr., M.D., New York** 613

PARTIAL EXCISION OF THE MOTOR CORTEX IN TREATMENT OF JACKSONIAN CONVULSIONS: RESULTS IN FORTY-ONE CASES. **Cobb Pilcher, M.D.; W. F. Meacham, M.D., and T. J. Holbrook, M.D., Nashville, Tenn.** 633

NONDRAINAGE AND EARLY AMBULATION IN CASES OF PERFORATIVE APPENDICITIS. **Arnold S. Jackson, M.D., Madison, Wis.** 644

ISOLATED PARALYSIS OF THE SERRATUS MAGNUS FOLLOWING SURGICAL PROCEDURES: REPORT OF A CASE. **Paul H. Lorhan, M.D., Kansas City, Kan.** 656

PROGRESS IN ORTHOPEDIC SURGERY FOR 1945. A REVIEW PREPARED BY AN EDITORIAL BOARD OF THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS (TO BE CONTINUED):

XV. FRACTURE DEFORMITIES. **Leonard T. Peterson, M.D., Washington, D. C.** 660

XVI. CONDITIONS INVOLVING THE KNEE JOINT. **Ralph K. Ghormley, M.D., Assisted by John C. Ivins, M.D.; Jackson E. Upshaw, M.D.; Joseph M. Janes, M.D.; Robert J. Graham, M.D., and Federico L. Padilla, M.D., Rochester, Minn.** 668

XVII. CONDITIONS INVOLVING THE KNEE JOINT. **Mark B. Coventry, M.D., Assisted by Cameron Allen, M.D.; Robert B. Elliott, M.D.; Alfred E. Jackson, M.D.; Einer W. Johnson, M.D.; Jack Paschall Jr., M.D., and Arnulf R. Pils, M.D., Rochester, Minn.** 682

XVIII. CONDITIONS INVOLVING SHOULDER, NECK AND JAW. **Toufick Nicola, M.D., Montclair, N. J.** 689

REVIEW OF UROLOGIC SURGERY. **Albert J. Scholl, M.D., Los Angeles; Frank Hinman, M.D., San Francisco; Alexander B. Hepler, M.D., Seattle; Robert Gutierrez, M.D., New York; Gershom J. Thompson, M.D., and Edward N. Cook, M.D., Rochester, Minn.; John F. Flynn, M.D., Los Angeles, and Vincent J. O'Conor, M.D., Chicago.** 701

GENERAL INDEX 733